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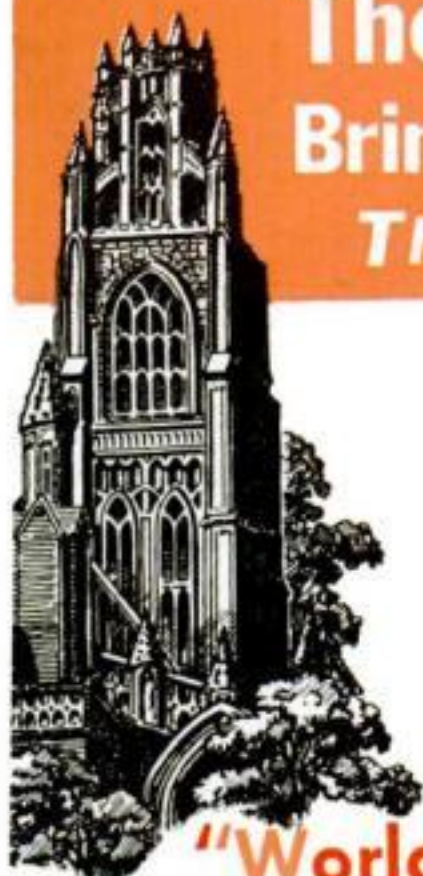
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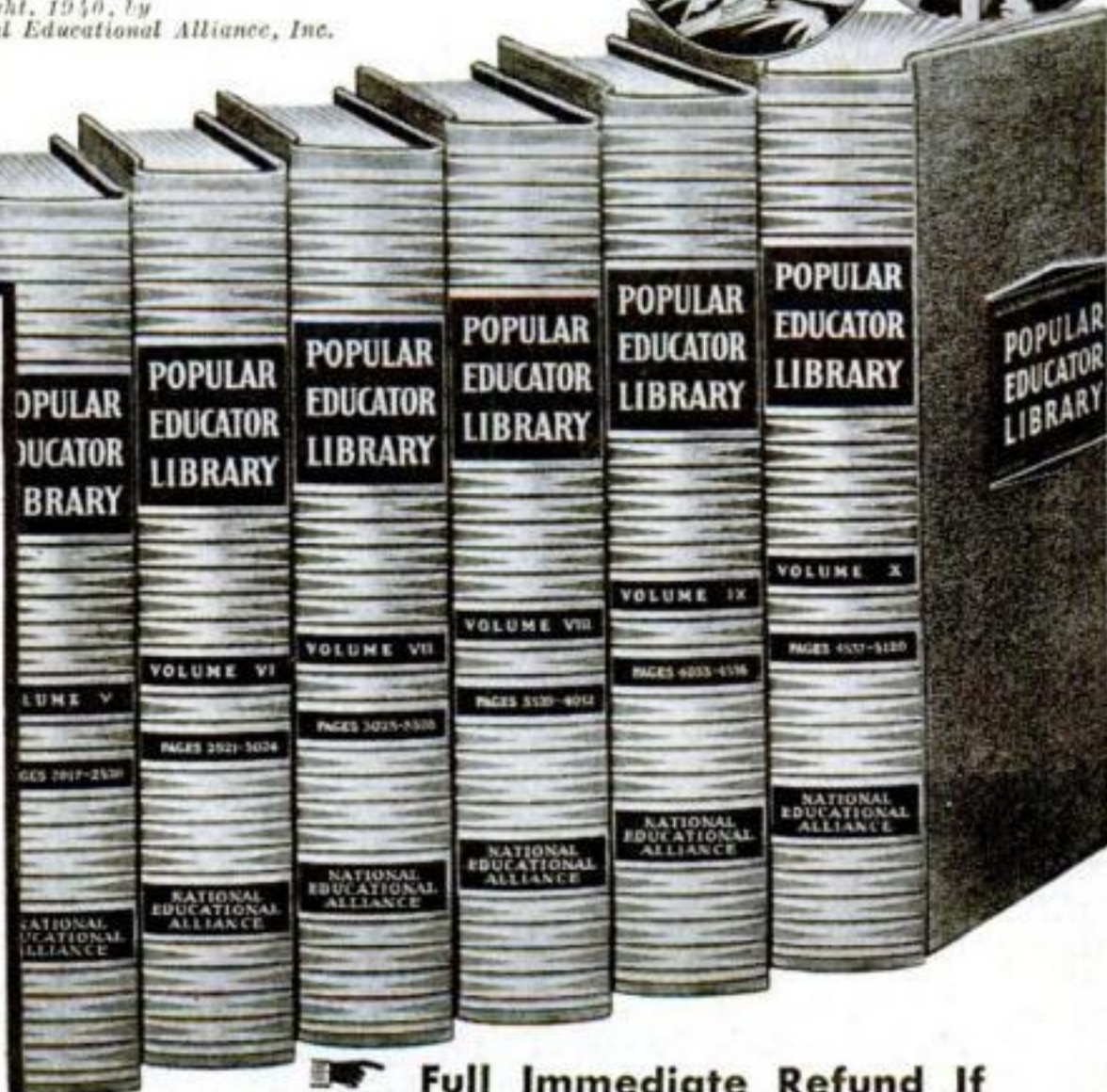
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VOL. 138 NO. 2

Mechanics & Handicraft

THE NEWS PICTURE MAGAZINE OF SCIENCE AND INDUSTRY

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CARL DREHER is a technician turned author. His background as a pioneer in radio and sound-movie work gives him an engineer's approach to the scientific and mechanical factors in modern war. In "Air Defense—1941 Style," he strips the bunk and hysteria from a question that all Americans are asking today. He likes Hollywood for company, comes to New York when he wants to be alone.

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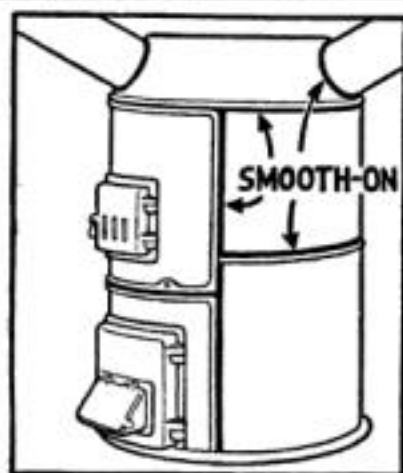
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HOW DID OUR
LANGUAGE
ORIGINATE?



Enchant

came from the witch's song

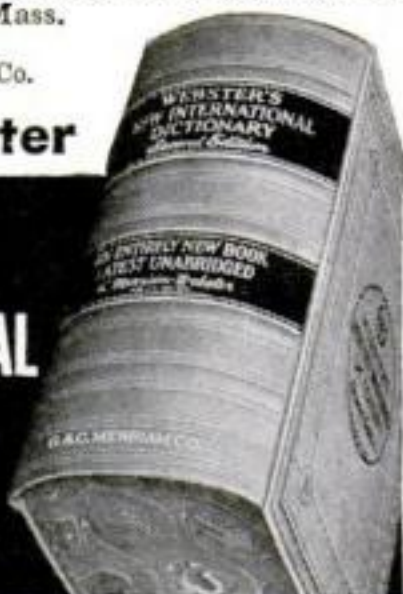
TO be *enchanted*, in the usual modern sense, is to be highly delighted or charmed—something very different from the original meaning. The word is ultimately descended from the Latin *cantare*, “to sing”; more immediately from its derivative *incantare*, “to chant or utter a magic formula over or against one,” “to bewitch.” This became Old French *enchanter*, which English borrowed as *enchant*. The first English meaning was still close to the original: “to act on by charms or sorcery.” Today *enchant* is used figuratively to mean “to enrapture,” as with music, beauty, or the like.

This is one of the thousands of interesting word origins given in the unabridged Merriam-Webster, WEBSTER'S NEW INTERNATIONAL DICTIONARY, Second Edition. This great reference book provides a wealth of general information. It contains 600,000 entries—122,000 more entries than any other dictionary. 12,000 terms illustrated; 3,350 pages. **WARNING:** The only genuine Webster is the Merriam-Webster. Don't be duped by so-called “Webster” dictionaries offered at fictitious “bargain” prices. Look for the Merriam-Webster name and circular trade-mark on the cover. Ask your bookdealer to show it to you. Write for free illustrated booklet of interesting word origins to G. & C. Merriam Co., 633 Federal Street, Springfield, Mass.

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the Genuine Webster

**WEBSTER'S
NEW INTERNATIONAL
DICTIONARY
Second Edition**



Coming Next Month —

GREAT MEN OF AVIATION got their start by experimenting with model planes. Today there's a drive on to create future greats by “air-conditioning” the young people of the nation. Winthrop Rockefeller heads Air Youth of America in one important phase of the campaign. John H. Walker reveals the absorbing facts in this move to build air power from the groundling up.

“**CHATTERBOX**” is the name the gun crew gives to its .50 caliber anti-aircraft machine gun. Why? Because it talks the language of war at the rate of 600 bullets a minute. A six-page picture story of Fort Tilden's gunners shows how they learn to “ride” the bucking babblers. It's a direct hit.

A **BLINDFOLDED MAN** with a clothespin on his nose can't tell the difference in taste between coffee and tea. So say the experts whose job is to sip and eat so that consumers can be sure of the quality of their food and liquids. Learn all about your taste buds in “Taste Engineers,” by Bert Andrews. (With that same clothespin and blindfold, the hungry and thirsty can make other tasting tests that will startle them, too.)

NOT SO LONG AGO foreign maritime powers, talking about America's merchant marine, used to say: “WHAT merchant marine?” But it's all different now, thanks to a program for building 500 commerce carriers in ten years and 50 a year thereafter. Pictures and text disclose what America is getting for its money—and why it's giving seagoing competitors a run for theirs.

BOBBY McBRIDE is a nautical-minded boy, and so his father, Clifford McBride, turned the lad's room into a ship's cabin. The elder McBride is a comic-cartoon artist, which perhaps is why he even devised an illusion that makes the room seem to roll gently, like a ship at sea. He gives away the secret, for anyone who wants to do the same, in “I Build a Room for Bobby.”

PLANNING A HOUSE isn't so hard if you start right and work from the inside out. Architects have it down to a system—a surprisingly simple one. This is explained for the layman by Henry H. Saylor, A.I.A., in “How an Architect Designs a House.” The article is packed with helpful hints for those who intend to enter the \$1,000 home-planning contest announced on pages 139-145 of this issue.

Fun As You Like It In Motorcycling



THRILL to a continual round of fun and excitement on a Harley-Davidson. Go when and where you please — evenings, week ends, or on glorious vacation trips to distant places or famous beauty spots. Pal with other fun-loving riders, at club rallies, race meets, hillclimbs and other rousing motorcycle events. See the exciting 1941 models at your Harley-Davidson dealer — and learn how easy it is to own one on his Easy Pay Plans.

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WORLD'S CHAMPION MOTORCYCLE

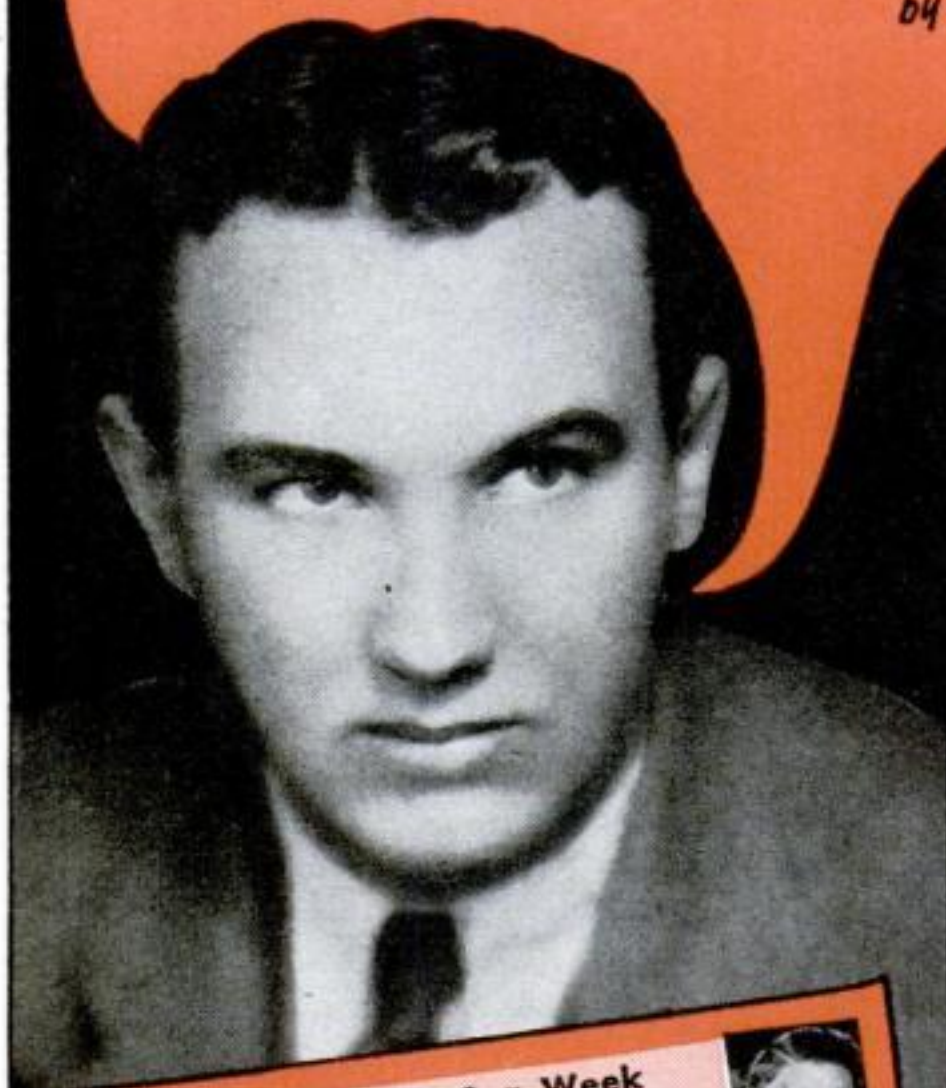
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Send pictures and descriptions of smart 1941 models.
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I Jumped from \$18 a week to \$50
--A FREE BOOK STARTED ME TOWARD THIS
Good Pay in Radio
--- HERE'S HOW IT HAPPENED
by S.J.E. (NAME AND ADDRESS SENT UPON REQUEST)



"When I finished training I accepted a job as Radio serviceman. In three weeks I was made service manager at \$40 to \$50 a week, more than twice my shoe factory pay."

Be a RADIO

Find out How I Train

If you can't see a future in your present job, feel you'll never make much more money; if you're in a seasonal field, subject to lay offs, IT'S TIME NOW to investigate Radio. Well trained Radio Technicians make good money, and you don't have to give up your present job or leave home to learn Radio. I train you at home nights in your spare time.

Why Many Radio Technicians Make \$30, \$40, \$50 a Week

Radio broadcasting stations employ operators, technicians. Radio manufacturers employ testers, inspectors, servicemen in good-pay jobs. Radio jobbers, dealers, employ installation and servicemen. Many Radio Technicians open their own Radio sales and repair businesses and make \$30, \$40, \$50 a week. Others hold their regular jobs and make \$5 to \$10 a week fixing Radios in spare time. Automobile, Police, Aviation, Commercial Radio; Loudspeaker Systems, Electronic Devices are other fields offering opportunities for which N.R.I. gives the required knowledge of Radio. Television and Frequency Modulation promise to open good jobs soon.

Many Make \$5 to \$10 a Week Extra in Spare Time While Learning

The day you enroll, I start sending you Extra Money Job

Makes \$50 to \$60 a Week

"I am making between \$50 and \$60 a week after all expenses are paid, and I am getting all the Radio work I can take care of, thanks to N. R. I."

H. W. SPANGLER
 126½ S. Gay St., Knoxville, Tenn.

Operator in Broadcasting Station

"I was chief engineer of KFPW, Fort Smith, Ark., for over seven years, which position I resigned to become transmitter operator of KGKO, Fort Worth, Tex., where I am now employed."

WILLARD DOAN
 406 W. First St., Arlington, Texas.

\$15 a Week Extra in Spare Time

"I am doing spare time Radio work, and I am averaging from \$700 to \$850 a year. Those extra dollars mean so much—the difference between just barely getting by and living comfortably."

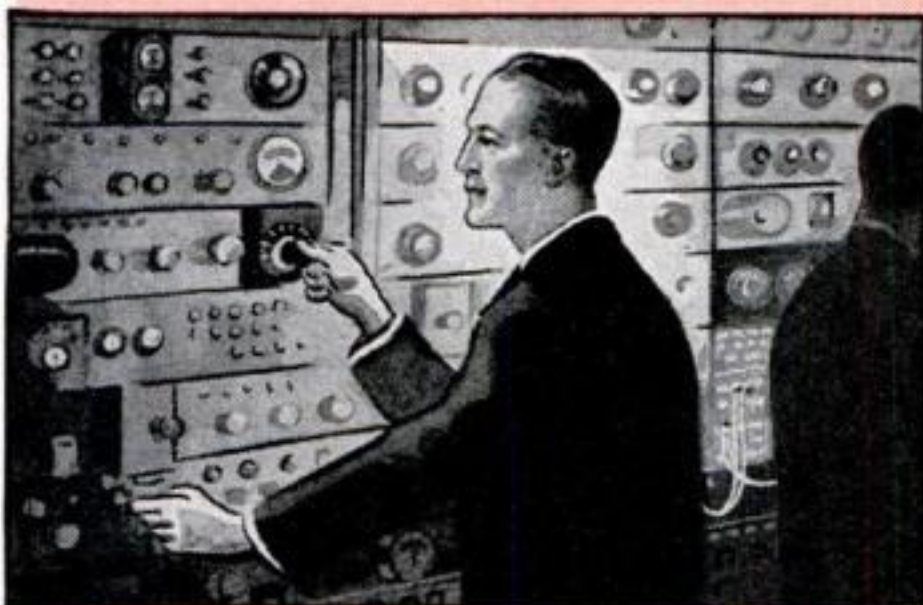
JOHN WASHKO
 97 New Cranberry, Hazleton, Penna.



"I had an \$18 a week job in a shoe factory." He'd probably be there today if he hadn't read about the opportunities in Radio and started training at home for them.



"The training National Radio Institute gave me was so practical I was soon ready to make \$5 to \$10 a week in spare time servicing Radio sets."



"Eight months later N. R. I. Graduate Service Department sent me to Station KWCR where I became Radio Operator. Now I am Radio Engineer at Station WSUI and connected with Television Station W9XK."



"The N. R. I. Training took me out of a low-pay shoe factory job and put me into Radio at good pay. Radio has enjoyed a colorful past. It will enjoy an even greater future."

Technician

You at Home



J. E. SMITH, President
National Radio Institute
Established 25 Years

He has directed the training of more men for the Radio Industry than anyone else.



Sheets—start showing you how to do Radio repair jobs. Throughout your Course I send plans and directions which have helped many make \$5 to \$10 a week extra in spare time while learning. I send special Radio equipment to conduct experiments and build circuits. This 50-50 training method makes learning at home interesting, fascinating, practical. YOU ALSO GET A MODERN, PROFESSIONAL ALL-WAVE, ALL-PURPOSE, SET SERVICING INSTRUMENT to help you make money fixing Radios while learning and equip you for full time work after you graduate.

Find Out What Radio, Television Offer You

Act Today! Mail the coupon for my 64-page book, "Rich Rewards in Radio." It points out Radio's spare time and full time opportunities and those coming in Television; tells about my Course in Radio and Television; shows more than 100 letters from men I have trained, telling what they are doing and earning. Read my money back agreement. MAIL COUPON in an envelope or paste on a penny postcard—NOW!

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City.....State.....

From the
News Editor's
Desk

SOAKING OAK in a concentrated solution of urea, then drying it and heating it to 212 degrees Fahrenheit makes it plastic and capable of being bent, twisted, and compressed. When it is cooled it resumes its normal hardness and rigidity. The Forest Products Laboratory of the U. S. Forest Service, at Madison, Wis., which developed this new process, has also discovered that urea-impregnated wood chips and sawdust may be compressed to a density similar to that of a basic wood fiber, with true thermoplastic properties, if it is first subjected to high temperatures and pressures. Technicians believe the new treatment is applicable to both softwoods and hardwoods, and that it has wide possible application in the production of cheap plastics.

SPLINTERS OF METAL or glass embedded in an eye can now be located with X-ray maps made while the patient wears a special contact lens over the injured eyeball. Four lead spots in the lens show up as white spots on the negative. The foreign body is located by comparing its position on the film with these spots.

ANATION-WIDE "CENSUS" of work days lost by illness or non-industrial injuries has just been begun by the non-profit Air Hygiene Foundation, of Pittsburgh, Pa. Record blanks, sent to coöperating companies and collected monthly, will list wage earners' absences and their cause. The U. S. Public Health Service, through speedy sorting and analysis, can then spot unusual prevalence of a particular ailment in a given district or factory branch. Trouble-shooters will investigate, and try to remedy the cause. The Foundation aims to reduce the enormous drain on wages, profits, and production caused by an estimated average of eight to twelve days a year away from work.

RUBBER THAT WILL TRANSMIT ELECTRICITY and simultaneously give off heat has been perfected by the United States Rubber Company. Electrically heated aviators' suits that weigh less and fit better have been delivered to the Army Air Corps. The transformation of non-conducting rubber into a resisting conductor is a recent research discovery.

SELF-CONTAINED, FLOATING POWER PLANTS are being studied by the General Electric Company as a national-defense aid. They could be towed to strategic points and hooked into regular distribution systems, through which they could serve a large portion of the West Coast and the eastern United States. A 50,000-watt plant could be housed in a hull 290 feet long, with a 43-foot beam, 10-foot draft, and a low bridge clearance of 15 feet.

How Big Is YOUR PAY-CHECK?

*If you earn under \$3,000,
Higher Accountancy may
be the answer for you*

"THE size of my pay-check? What business is it of yours?" Perhaps that's the first reply that comes to your mind.

But—stop a moment. It really *is* our business—to help men just like you. In fact, it's been our business here at LaSalle for 30 years.

If your pay-check isn't all that you'd like it to be, why not consider accountancy? Why not become a member of this well-paid and respected field? Why not, in short, prepare yourself to earn real money—insure a good home for your family—a new car—an education for the growing youngsters—a bank account for a rainy day . . . these and many more of the precious things in life?

Maybe you're one of those ever hoping for "breaks" that will give you a higher standard of living. Yet that's precisely what most of 30,000,000 other employees in this country are doing.

Not all of them, of course. Here and there you find ambitious men who aren't depending on luck to carry them ahead. They're following a tested path to increased earnings—leaving nothing to mere chance. They're *training* themselves for better jobs—every week spending a few hours in serious but interesting study at home.

Some day, as expert bookkeepers and later as accountants, these determined men will have standing and a considerably larger income—in a profession that pays and pays well.

Why don't *you* do as they are doing—take advantage of LaSalle training? Even though you do not know the fundamentals of bookkeeping now—you nevertheless may have an excellent opportunity to master accountancy. Many others have done it.

Perhaps you're asking yourself, "But don't these others possess natural ability that I lack? Don't I need a special talent for all this?"

Ask rather, "If I do my part, won't *I* get results, too?"

You will! For all it takes is intelligence, serious study and work—not genius. Under the LaSalle system you solve problems by simple steps . . . from day to day, as an expert accountant does. You use the same basic principles. And when these problems become difficult and puzzle you, you get counsel that could be matched only through personal coaching by a battery of experts in a big accounting house.

In a comparatively short time, you train yourself in Elements of Accounting, Principles of Account-



ing, Auditing, Cost Accounting, Business Law, Organization, Management and Finance. The training—complete and intensive all the way—takes you right into C.P.A. coaching if you desire.

Later, when you're an accountant, it may be possible to go into business for yourself as a public accountant and be independent. Or, if you choose to work for someone else as an executive accountant, it well may be for a salary several times that which you draw now.

Write for this FREE book

If you're tired of pinching pennies, investigate accountancy and LaSalle training. There isn't a faster, less expensive or more convenient method to master accountancy. Fill in the coupon and mail. We'll send you our 64-page book, "Accountancy, The Profession That Pays."

Then, when you read all the facts, you yourself will be able to judge best whether you have the will to study and apply your best efforts—toward a more secure future.

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Present Position.....Age.....

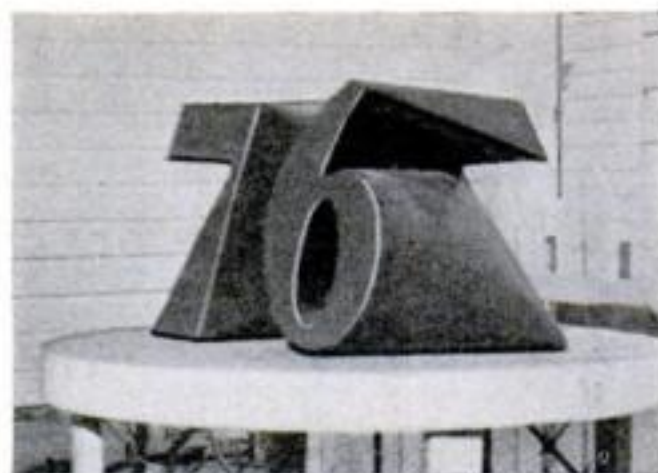
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Readers Say:

However You Look at This Two-Way Sign, It's a Good Exercise in Geometry

IN THE hope that your readers might be interested in the work that can be done with sheet metal, I am sending a snapshot of a metal sign I made in my spare time. As you can see, the sign reads "76" on both sides, the "7" on one side being transformed into the "6" on the other side.—A. Z., San Bruno, Calif.

Anyone who has tried drafting even the simplest of patterns, perhaps for a lamp shade or a sheet-metal elbow, should appreciate the perplexing geometric problem solved by the maker of these "transition pieces."—Ed.



An Old Copy of P.S.M. Made Him Forget Bombs

AT THE time of the invasion of Norway last spring, I was living in Oslo and a bomb missed our house by only 75 feet. The next day, while I was busy clearing my room of broken glass and picking bomb splinters out

WHO BAN CARE ABOUT
BOOMBS NOW!



of the walls, I came across a copy of P.S.M. In spite of the glass I sat down on the floor and forgot all about bombs until I was dragged back to work. I can assure you that more than one foreign student has improved his technical vocabulary by reading your excellent magazine. This is admitted by principals of U.S. schools receiving foreign students.—L. V. B., Boston, Mass.

Pit Helps the Pit Viper To Pick a Bare Spot

IN "UN-NATURAL HISTORY" for December, Gus Mager says that no one knows what the pit or depression between the eye and nostril of the pit viper is for. The late Dr. Noble of the American Museum of Natural History found that the pit enables the pit viper to discriminate between warm and cold objects moved in front of the head, and so presumably assist in the detection of warm-blooded prey. These depressions are, then, thermometers that give warning when the pit viper is near exposed body surface as it moves toward its victim, enabling it to avoid furred or

clothed parts of the body and so strike in a more effective location. Thus, the lethal ability of the viper is increased. Another function of the pit, which had been suspected earlier, is to detect some air vibrations.—W. A. B., New York City.

Anybody Know How To Make a Home Stereoscope Projector?

AS YOU know, three-dimensional pictures are coming back. Stereoscopes and pictures are offered for sale, and such pictures have been projected for public exhibition. I have been taking three-dimensional pictures for four years, and would like to see your magazine the first to show a simple method of projecting them in the home. There must be a way of doing it, using polaroid lenses for projecting and glasses for viewing the screen.—C. L. S., Cohoes, N. Y.

Can any of our readers suggest a solution for C. L. S.'s problem?—Ed.

He Would Use an Ear Trumpet for Reading His Mail

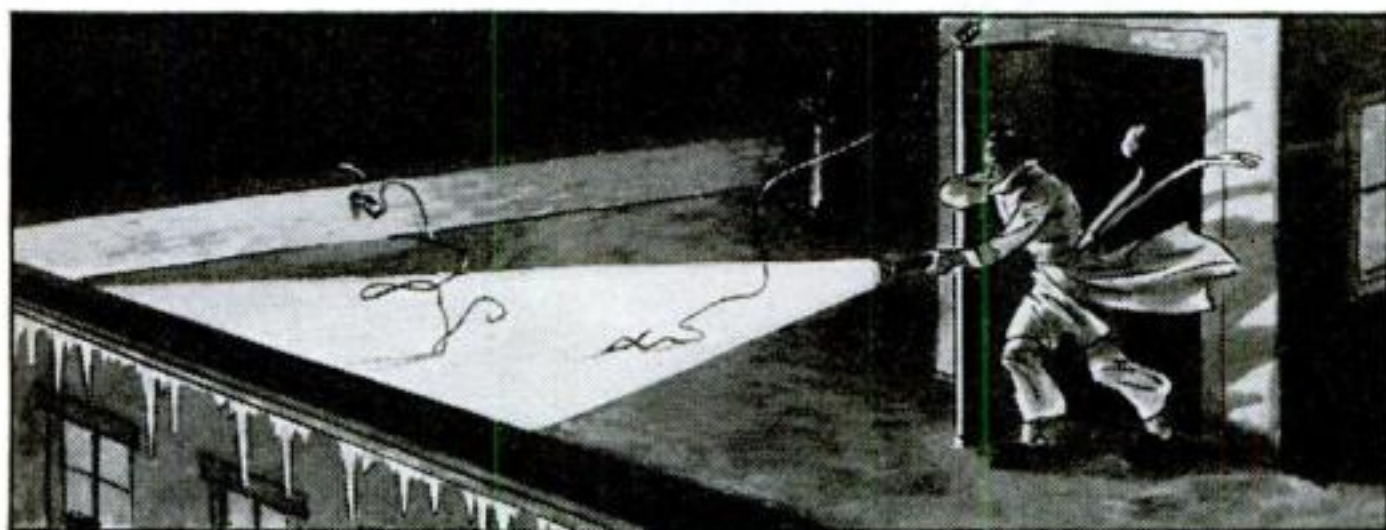
IN YOUR "With the Inventors" department you describe a hearing-aid device concealed in the frames of a pair of eyeglasses. Mightn't it seem peculiar if a visitor pulled out a pair of these spectacles and proclaimed: "Pardon me, but I can't hear a word you say without my glasses"? — B. G. M., Chicago, Ill.

HOW'S THIS FOR A HOME-
WORKSHOP
VERSION?



"I CHEATED DEATH ON A SKYSCRAPER ROOF!"

A true experience of ALLEN H. GIPSON, New York City



"ONE BITTERLY COLD NIGHT, my radio went dead," writes Mr. Gipson. "Suspecting that the howling wind had blown down the aerial, I threw on a dressing gown, grabbed my flashlight, and headed for the fifteenth floor roof.

"AN ICY WIND chilled me as I searched for and found the aerial. Making hasty repairs, I started back down. To my horror, I found myself locked out. I battered the door. I shouted. But the wind howled me down.




"NEARLY FROZEN TO DEATH, I had an inspiration. Ripping the aerial loose, I tied the lighted flashlight to it, and swung it over the side of the building. Luckily the light attracted someone in an apartment below. Thanks to those dependable 'Eveready' fresh DATED batteries I was saved.

(Signed) *Allen H. Gipson*

The word "Eveready" is a registered trade-mark of National Carbon Company, Inc.

FRESH BATTERIES LAST LONGER... Look for the DATE-LINE

NATIONAL CARBON COMPANY, INC., 30 EAST 42nd STREET, NEW YORK, N. Y.
Unit of Union Carbide  and Carbon Corporation



Readers Say:

Even the Car of the Future Gets Out a New Model

AWAY back in June, you showed on your cover "the car of the future," due to come in two years. The body was high with many windows. Then in November you showed "the car of the future" again, but it was very different, with a low body and hardly any windows. Now, which will really be the car of the future?—H. A., New York City.



What the car of the future will really be like is anybody's guess. H. A. can take his choice.—Ed.

What the car of the future will really be like is anybody's guess. H. A. can take his choice.—Ed.

That "Audio" Telegraph Is a World War Baby

THE homemade "audio" telegraph described in your December issue is neither new nor novel. This very practical method of signal transmission was used by the French and by us during the World War 22 years ago. It was known as the T. P. S. (*Telegraphie par sol*), worked from company headquarters to regimental headquarters. Had an extreme range of two miles with a 200 or 300-foot base line, provided a stream or barbed-wire entanglement did not intercept the magnetic field. The base lines were laid out with the aid of a compass. The transmitter was a large induction coil operating from a ten-volt storage battery. Receiver was the French three-tube type with connections for amplifying crystal signals or picking up T. P. S. and radio. This circuit was also used for listening in on grounded telephone lines.—R. M. H., Oakmont, Pa.

HEY, BUTCH IS TRYIN' TO DATE UP MARIANNE AGAIN!



Our thanks to R. M. H. for this side light on the interesting past of the "audio" telegraph, alias *telegraphie par sol*.—Ed.

Try This Stroboscope Stunt On Your Own Car

THOSE letters about wagon wheels in the movies seeming to go backward reminded me of a trick I have been showing people for years at my service station. After dark, with a 60-cycle A. C. electric light, start an automobile engine and note the way the fan is turning. Speed up the engine gradually and the fan will seem to slow down, come to a stop, and then start turning in the opposite direction. It mystifies nearly everybody, as few people know that 60-cycle alternating current is on and off 60 times a second. I first noticed this trick as a lad, while spinning a jack (the kind children play with) on a table under an A. C. light.—J. E. H., Beaver Falls, Pa.

And Who Ever Saw a Hairless Polar Bear?

ONE of your readers asked recently whether he could keep his whiskers from growing if he stayed in a cold place. All the arctic explorers whose pictures I have seen were pretty well upholstered with hair, and Admiral Byrd's men certainly had more than their share of whiskers. Why doesn't your reader try dipping his face in a bowl of liquid air to freeze his whiskers? Then they'd be so brittle he could just brush 'em off. Well, they laughed at Columbus, too.—W. A. T., Chicago, Ill.

THE BEAR THIS RUG CAME FROM WAS HAIRLESS WHEN I GOT THROUGH WITH HIM!



Here's a Problem To Solve Some Saturday Night

A TANK is fed by two taps and drained by a single drain. With the drain closed, the first tap can fill the tank in five minutes, while the second tap can do the same in six minutes. Both taps working jointly with the drain open can just fill the tank in $7\frac{1}{2}$ minutes. How long will it take to drain the full tank? The answer must be correct to six decimal places.—H. J. A., Jr., Paterson, N. J.

O.K., We'll Let Him Off—He Needn't Solve Them

ALTHOUGH I specially like your "Readers Say" department, I sometimes get provoked at those brain teasers your readers send in. When I sit down to read your magazine, I do so for enjoyment and not to have a nervous breakdown trying to solve problems.—J. M., Galesburg, Ill.

J. M. is excused from solving problems.—Ed.



**DOES YOUR
PAY ENVELOPE
KEEP YOU OUT
OF THIS PICTURE?**

IF IT DOES, do something about it! Get a raise in salary — but first get the training that will entitle you to this raise. Thousands of men in the same fix as you have gotten this training by spare-time study of an I. C. S. Course.

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IDEAS for HOME OWNERS

MORE HEAT FROM RADIATORS may be obtained by using an aluminum foil which is marketed in rolls, like wrapping paper. A sheet of the proper size is cut from the roll and slipped between the radiator and the wall. Acting as a heat reflector, the foil prevents the wall from absorbing heat, and causes 95 percent of the radiant heat from the radiator to be projected into the room. It also reduces the soiling of curtains by dust and smoke wafted upward on heated air. Dirt and dust accumulations do not interfere with the efficiency of the foil, for they do not block the invisible heat rays which it reflects.



STREAMLINED AIR COMPRESSOR. Resembling a table-model radio receiver, a portable air compressor with a two-tone enamel finish is now being produced for those who want style as well as utility in their paint-spraying equipment. Rated at $\frac{1}{2}$ horsepower, it delivers 4.55 cubic feet of air a minute at a pressure of 45 pounds to the square inch, and can be plugged into an ordinary house-current electric outlet. It weighs 72 pounds, and is fitted with rubber-tired swivel casters so that a painter can haul it after him as his work takes him around. The compressor unit may be purchased alone, or with four different sets of spray-equipment assemblies adapted to various kinds of work.

A DOUBLE-ENDED OUTLET BOX is being manufactured to simplify installation of electrical switches and outlets in thin wall partitions. Two switches or outlets may be placed beside each other, facing in opposite directions to serve rooms on opposite sides of the wall. The box is made of rustproof metal and will take standard switches and outlets. Wire connections may be made through any of the four narrow sides of the box. Openings for wires are made by knocking out one of the round designs on the housing.



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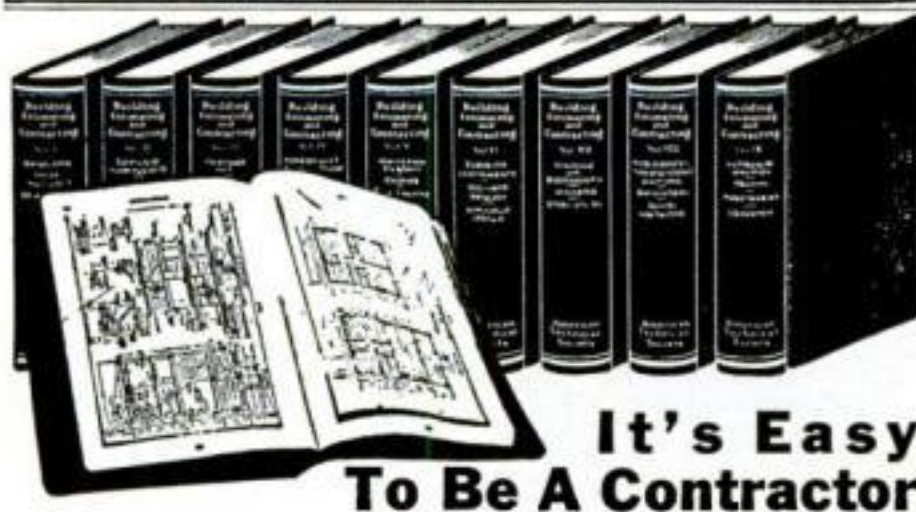
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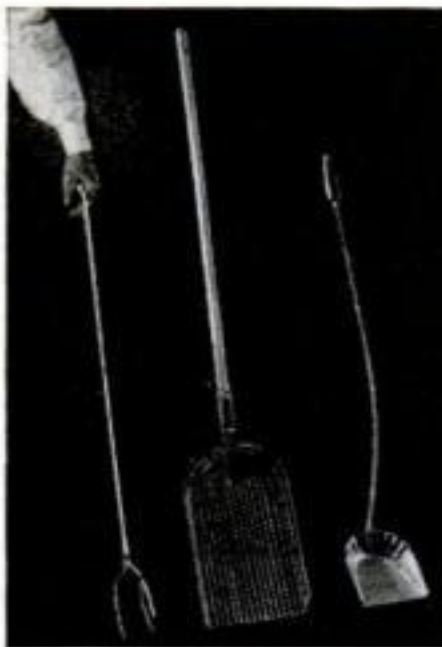
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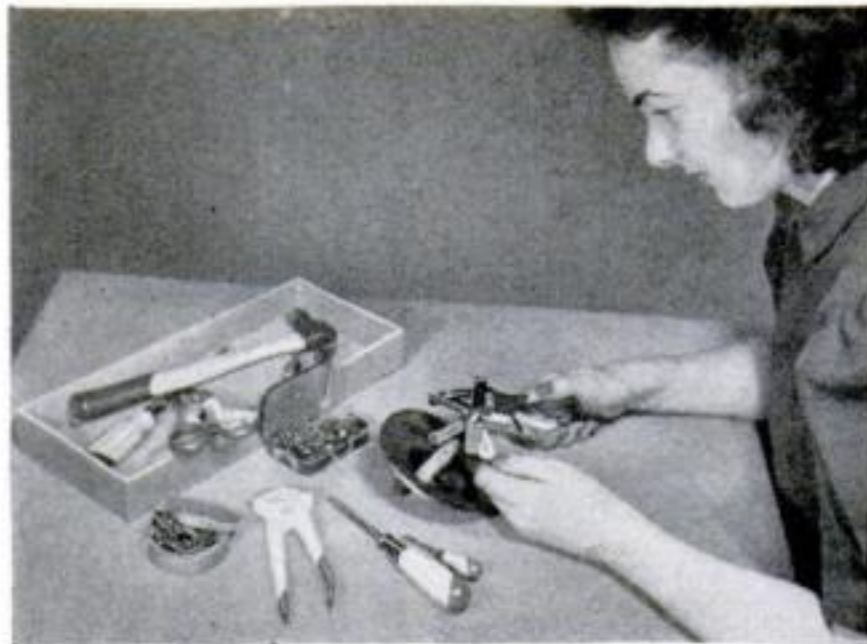


Formed in molds at the building site, cotton-and-concrete shingles are applied while wet

SHINGLES of cotton fabric and concrete were introduced recently in Jackson, Miss. Formed in a mold at the building site, they are placed on the roof while still wet and flexible. As they dry, during a curing period of 28 days, the shingles bond together, producing what is in effect a one-piece roof. The nails are driven while the shingles are wet, and when they dry the nails are firmly fastened by the concrete and cannot work out.

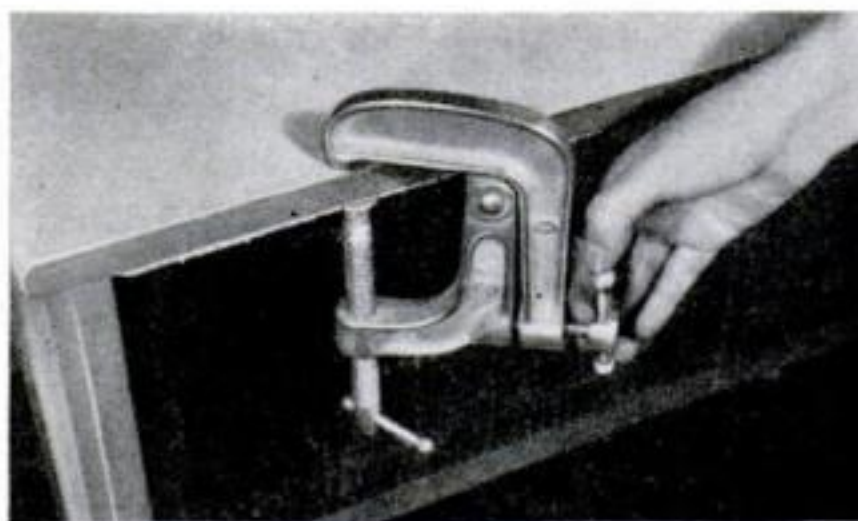


FURNACE TENDING is simplified with these modern tools. The set has an ash shovel, tongs for removing clinkers, and a wire shovel for sifting ashes in the ash pit, so that unburned fuel can be returned directly to the fire box without allowing dust to escape and settle in the furnace room.



A KIT OF SMALL-SIZED TOOLS has been designed for women who like to do jobs around the house, such as hanging pictures, fixing curtain rods, or laying shelf paper. Finished in blue and ivory enamel and sold in a blue-and-silver case, the set consists of a hammer, slip-joint pliers, a scratch awl, carpenter's pincers, tin shears, three screw drivers, and boxes of screws and nails. A jingle printed inside the cover warns other members of the family to keep hands off.

THE HEAT OF THE SUN is kept out of the house with a window screen resembling a miniature Venetian blind, which also bars insects without obstructing view or ventilation. It is made of horizontal bronze slats held in place by bronze wires. The slats are as close as the wires of an ordinary screen, and no direct rays can pass through if the sun is above an altitude of 40 degrees. Sloping at an angle of 17 degrees, the strips reflect heat rays outside the house.



A BETTER GRIP, which prevents creeping and shifting of material under pressure, is said to be possible with a new clamp built with a hinge and a vise screw. The clamp screw turns in a hinged bracket, and the hinge acts as a fulcrum with the base of the clamp, which the vise screw works against it. Extra slip-on jaws are provided for clamping pipes and tubing.

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"Why I thought of that years ago!" How many persons have said that, when they found later that somebody else had thought of the same thing, had it patented, sold it, and were profiting from it? Too many, sad to say. These unfortunates did not know what to do about their inventions, in order to protect and profit from them. Some thought elaborate working models were necessary to secure a patent—others felt their idea wasn't "worth much." They failed to realize that a good practical invention, plus prompt action in securing a Patent, and locating a buyer or a good market, have proved the secrets of success for thousands of inventors.

Patent Guide Shows What To Do

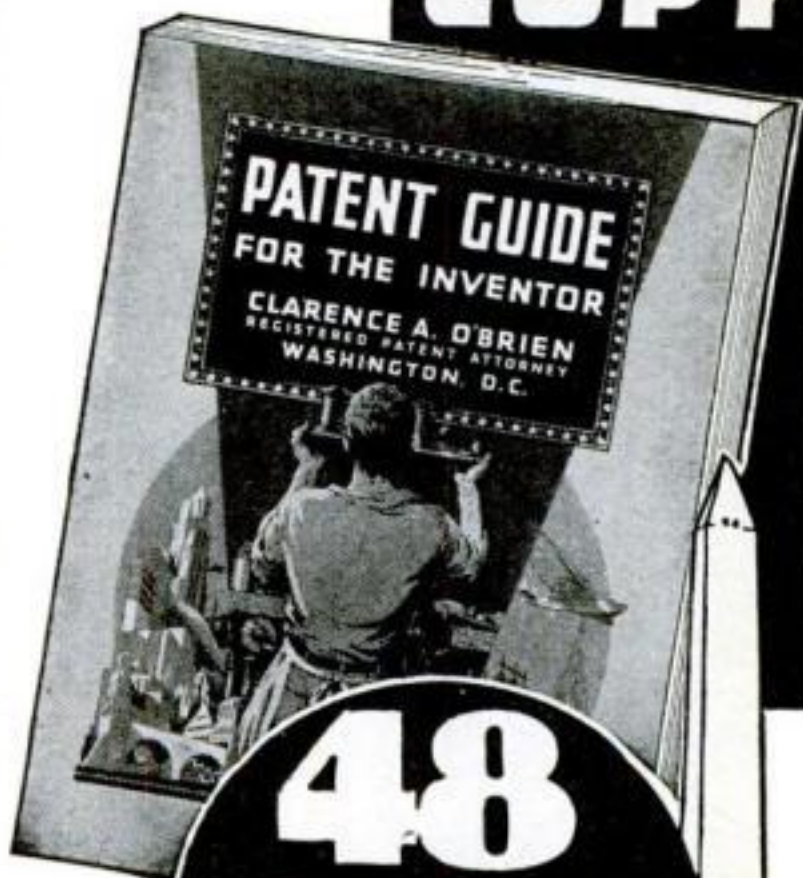
Our "Patent Guide for the Inventor" answers many important questions concerning Patents that inventors constantly ask. It tells what facts, details, drawings, sketches, etc. are necessary to apply for a Patent; how to protect your invention through dated and witnessed disclosure; how to do this AT ONCE to safeguard your rights; how Patent Office Records can be checked to determine whether the invention is probably patentable before filing fees need be paid; discusses costs involved and a practical way these can be paid as the application progresses. It tells how some inventors secured financial backing; how many simple inventions have proved large commercial successes; how Patents covering improvements also can be profitably utilized and marketed; tells countless other facts of interest.

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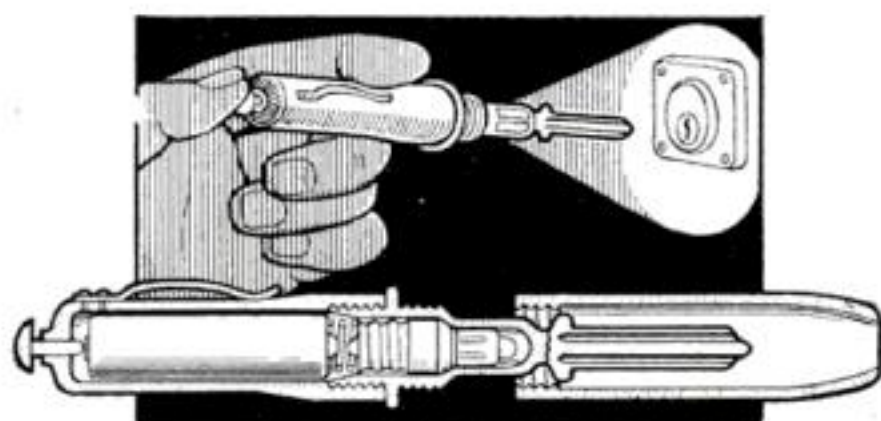
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With the Inventors

FINDING the keyhole at night has been made easy by Charlotte Cramer, of New York City, who combines the key with a handy flash-light holder that may be clipped to the pocket. Returning home, the user simply unscrews a cap over the key portion, and presses a button at the opposite end



that turns on the light. The resulting shaft of illumination aids in inserting the key in the proper position. When the light is no longer needed, releasing the button allows an internal spring to force the flash-light cell out of contact with a terminal of the lamp bulb. The cell may be used a long time without changing, since it is employed only occasionally, and then for just a moment or two. . . . **INVENTIVE TEAMWORK** between H. C. White and Max Powell, of San Gabriel, Calif., has produced a germless toothbrush.



Each tuft of bristles, at its base, enters a solid layer of bactericidal material, which is slightly soluble in water. Rinsed before use, the brush becomes freshly sterilized, which makes it incapable of transmitting germs to the mouth. . . . **THINGS** that people would like to have invented, according to a recent survey, include rubber fenders that would bounce off

garage doors, vest-pocket air conditioners, chip-proof nail polish, synthetic furs, fire-proof wood, transparent steel, and atomic energy. . . . If you play an A natural when you should have struck A sharp, perhaps

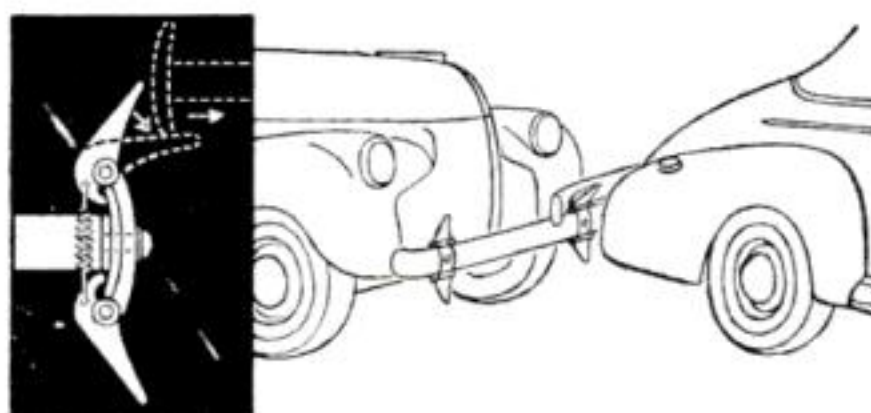
(Continued on page 24)

only the lighting over your piano is to blame. To aid the eyes of performers, and spare the ears of listeners, built-in piano lamps have been invented by William Zaiser, of Rockville Center, N. Y. From windows in recesses at each end of the keyboard, concealed bulbs cast their glow over the black and white keys, and illuminate the music as well. The patent has been assigned to one of America's leading makers of pianos.

. . . **ONE OF THE COUNTRY'S** most prolific inventors, Carleton Ellis of Montclair, N. J., is still going strong. His latest patent covers a printing ink that stays moist at ordinary temperatures, but dries quickly under



heat. . . . **UNTANGLING LOCKED BUMPERS** usually involves fruitless backing and pushing, a policeman, a crowd of bystanders, and the finally successful efforts of a crew of volunteer helpers. For motorists who would avoid this experience, Oscar H. Goetz, of Chicago, offers an ingenious device. Winged extensions are bolted near each end of the regular bumper. Pivoted and held vertically by a spring, the wings resist a backward push. But if a car ahead somehow becomes entangled with them, they readily rock forward and allow him to pull away, without



damage to cars or tempers. . . . **FIREWORKS OF DEATH** are shot from pistols designed by G. E. Giroux, Jr., of New York City. Pulling the trigger of one type hurls a rocket-propelled aluminum tube 1,500 feet in the air,

INVENTORS



Look Ahead

THIS is the time of year when ambitious, forward-thinking men *look ahead*, lay plans for the future that may mature into profitable reality. Last year the record-playing attachment for radios became a reality and sold like "hot cakes" at a low popular price. Women's clothes were almost revolutionized by the intro-

duction of the "house coat." The "electric nurse"—a guard against kidnappers—hit the market with a bang. Portable air-conditioners went up in value, down in price. The gearless hydraulic transmission has become a practicality. Farmers saved thousands of dollars with electric fencing.

Every year brings new inventions. There will be more in 1941. Smart men will plant the seeds of invention in the fields of industry, and reap the harvest when it is ripe. So do your spring "idea planting" early.

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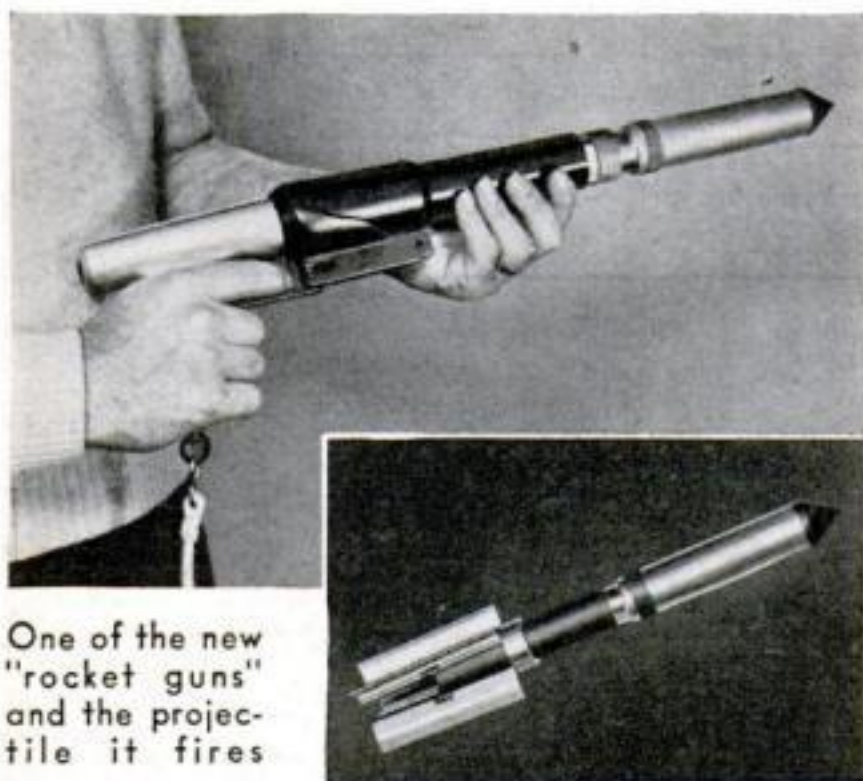
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With the Inventors

(Continued from page 22)



One of the new "rocket guns" and the projectile it fires

where it begins to emit a dazzling flare. Drifting slowly downward on a rubber parachute, it turns night into day while machine gunners and snipers wipe out enemy patrols. Another gun fires a "rocket grenade," with a bursting charge of T.N.T., at machine-gun positions far beyond range of hand grenades. Guiding fins of both types of projectiles, folded within the gun barrel, are opened automatically by springs on leaving the muzzle. . . . "ROCKING HEELS" for women's shoes, declares Evelyn Jahncke of New York City, give added comfort, a more natural step, and extra wear. Seen from the side, the base of the heel is a perfect



semicircle; from the back, a straight line. The resulting "half cylinder" imparts a rolling motion to the step, which is said to minimize fatigue. . . . SEIZE A COTTER PIN with a convenient new tool, and it comes out in a jiffy. Handled like a pair of pliers, the implement grasps the cotter pin just behind the eye, with one of its jaws.

The other jaw, of hooked shape, penetrates the eye itself. The result is an irresistible grip, according to the inventor, George J. Cynoske, of Middletown, Conn. Designed

especially for its job, the tool is declared particularly useful in removing a large number of cotter pins at once. Its flattened lower jaw adapts it to work in close places. . . .



PRIMED WITH WATER from a special rubber dropper, a self-humidifying pouch will keep tobacco just moist enough for days at a time. From the filler opening, cotton wicks lead the water to inside seams, and it slowly evaporates from exposed fabric. No free water comes in contact with the tobacco, and a spring-operated ball seals the filler opening against air and dust. . . . EACH MAJOR POWER has contributed its share of war weapons. Even soldiers with firearms carried separate swords for hand-to-hand combat, until a Frenchman attached a sword to a gun and created the first bayonet. France also originated the famous "75"—which, with modernization, still is the world's most effective small field gun. Germany intro-



duced steel armor plate, the rifling of firearms, and Zeppelins. Britain pioneered with torpedoes, tanks, shrapnel, and modern battleships, of which the prototype was H.M.S. *Dreadnought*. America first produced airplanes, submarines, and the machine gun—originally called the Gatling gun for its inventor, Richard Jordan Gatling. He believed that such a mechanized weapon would enable fewer soldiers to fight battles, and would thus reduce bloodshed. . . By devising a finger-moistening solution of glycerol and a resin in alcohol, for flicking through stacks of papers or money, an inventor eliminates the insanitary practice of wetting the fingertips with the lips. Clerks, bank tellers, and others who handle papers and currency would keep a container handy.

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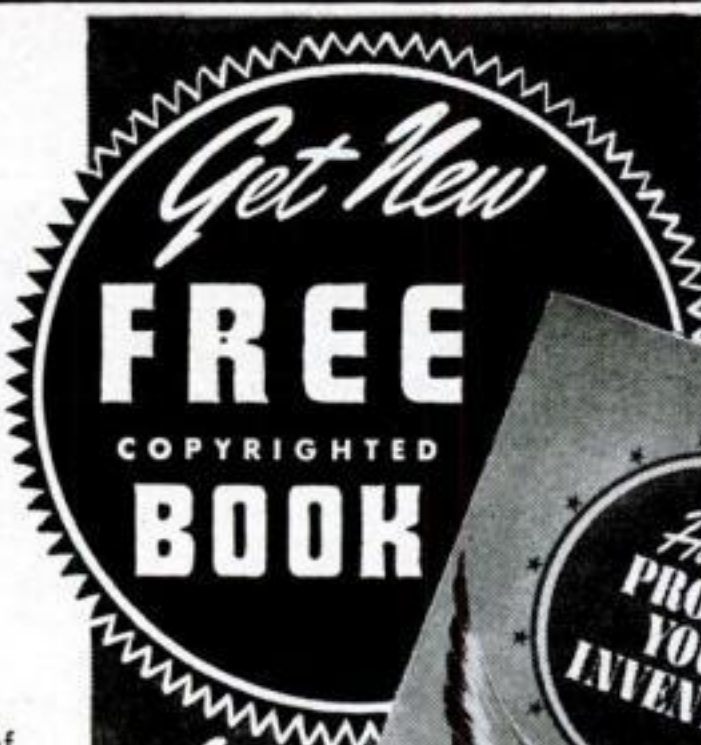
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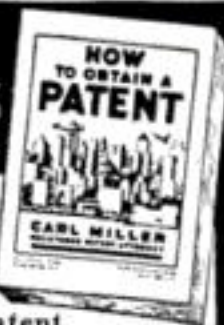
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2. Use only pencil or pen.

3. We return no drawings.

4. Print your name, address (town, county, state), age, occupation on back of drawing.

5. All drawings must be received by January 31st, 1941. Prizes will be awarded for drawings best in proportion and neatness by Federal Schools Faculty.



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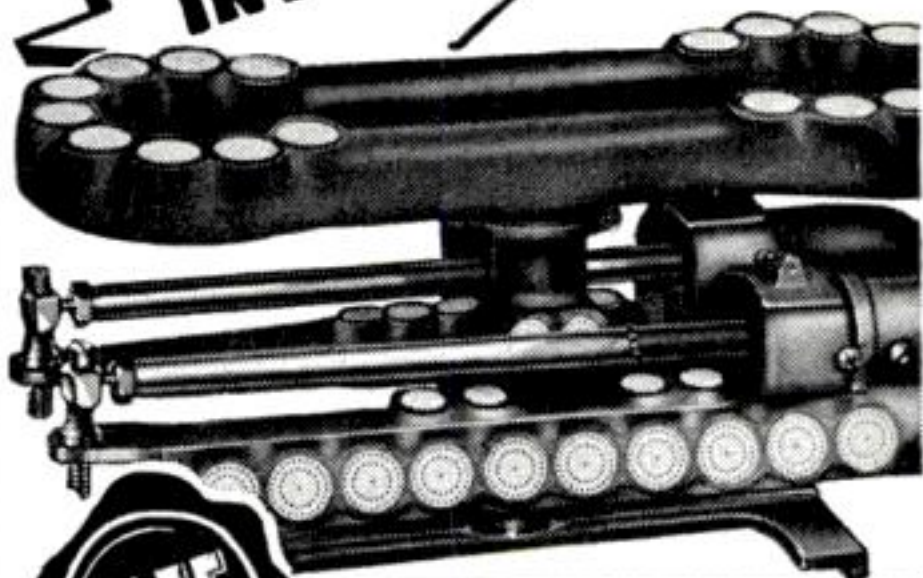
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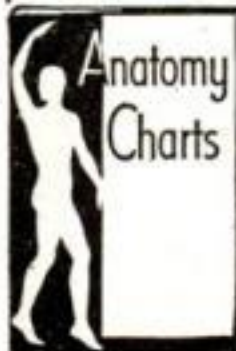
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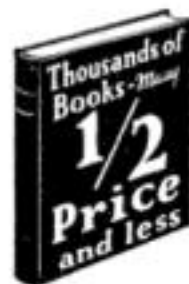
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MAN OF THE MONTH

The synthetic chemist watches
the mixing of a revolutionary
plastic glue (next page)

Chemistry Creates a Resin Glue for Everybody

By **HICKMAN POWELL**

Photographs by **ERIC SCHAAL**

EVERY month brings news of some fresh synthetic wonder created in the chemical laboratory. But usually you have to wait for years before you can get your hands on any of the stuff, and then it is probably a mere part of finished factory goods. Such has been the case with synthetic-resin glue, that marvelously tough, waterproof type of adhesive which has recently been revolutionizing the furniture and plywood industries.

This month's news is that a method has been developed by which urea formaldehyde resin glue is made available to everybody. You don't have to have a hot-plate press in order to set it. It won't turn into a solid block of resin before you get a chance to use it. It has just been put on the market, under the trade name of Casco-mite, for individual craftsmen.

This is a matter of interest to anyone who has a broken piece of furniture or a loose piece of veneer in the house (and who hasn't?). It is of real importance to those who build things at home, especially to those who have been experimenting with the building of boats from waterproof plywood and have been needing a thoroughly waterproof glue to bind the joints.

Up to the present, casein glue has been the most durable and water-resistant adhesive available to the general public in the United States, and in recent years it has attained a very wide acceptance among people who wanted to make things stick. The Casein Company of America, which put it on the general market, has now developed the new urea glue, said to be as far an advance over casein as the milk product was over the old animal and starch adhesives.

W. F. Leicester, head of the Casein Company's glue business, is so enthusiastic about the new resins that he hopes they make his standard casein glue, Casco, obsolete in woodworking.

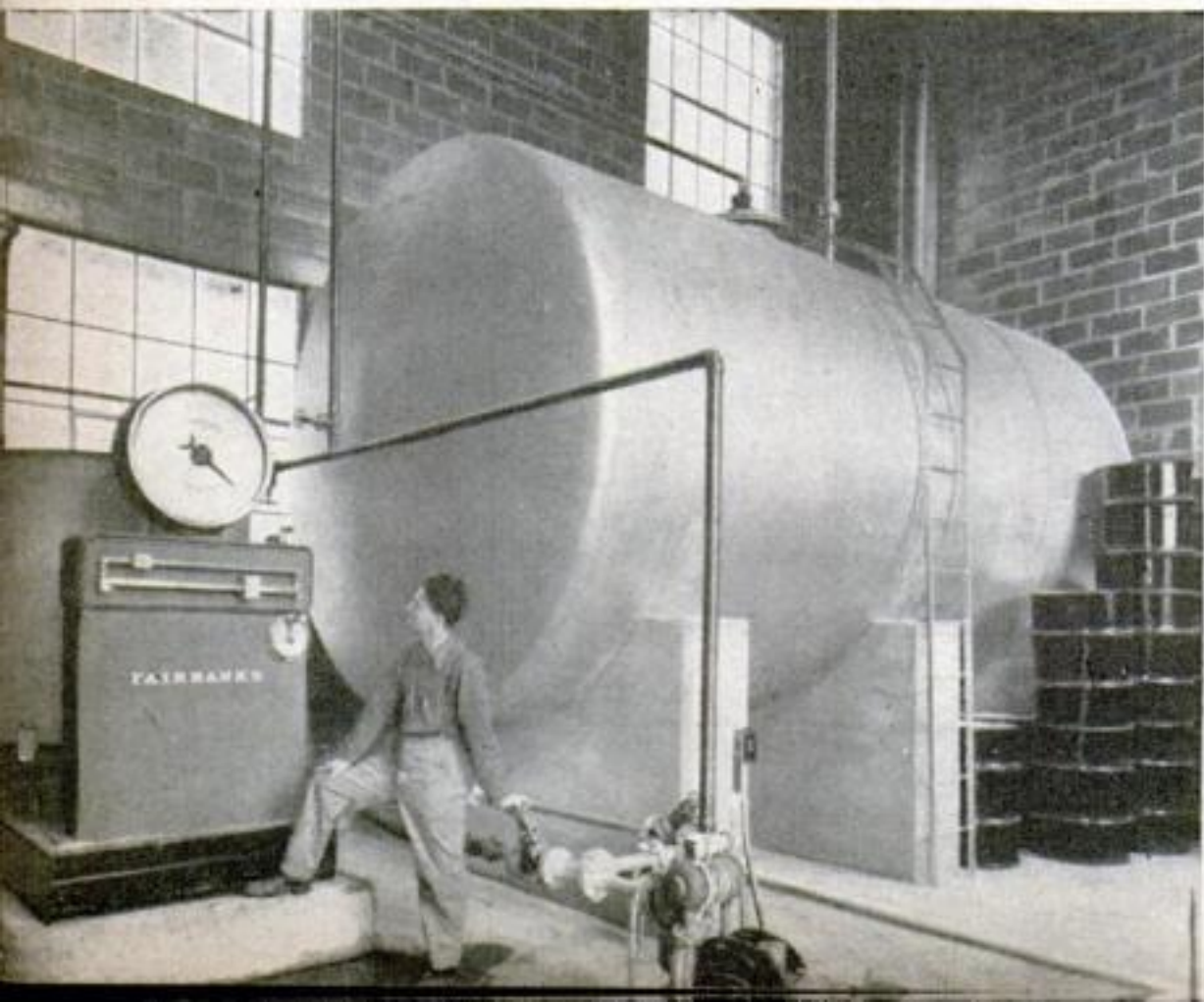
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One of the main ingredients of the new Casco-Resin glue is crystal urea, which is produced synthetically by Du Pont . . .

. . . and the other is formaldehyde, being weighed below from a 12,000-gallon tank at the Casco plant in Bainbridge, N. Y.



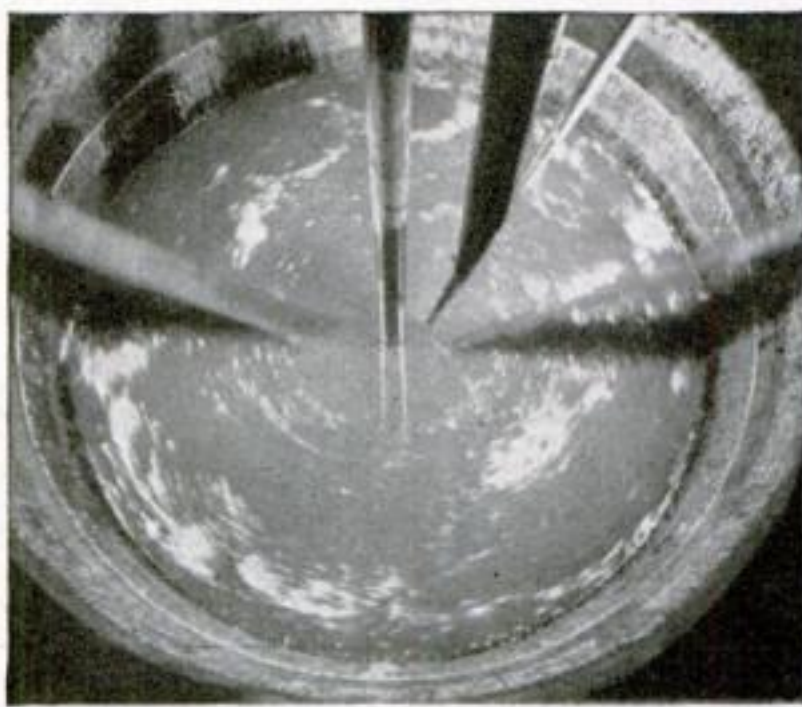
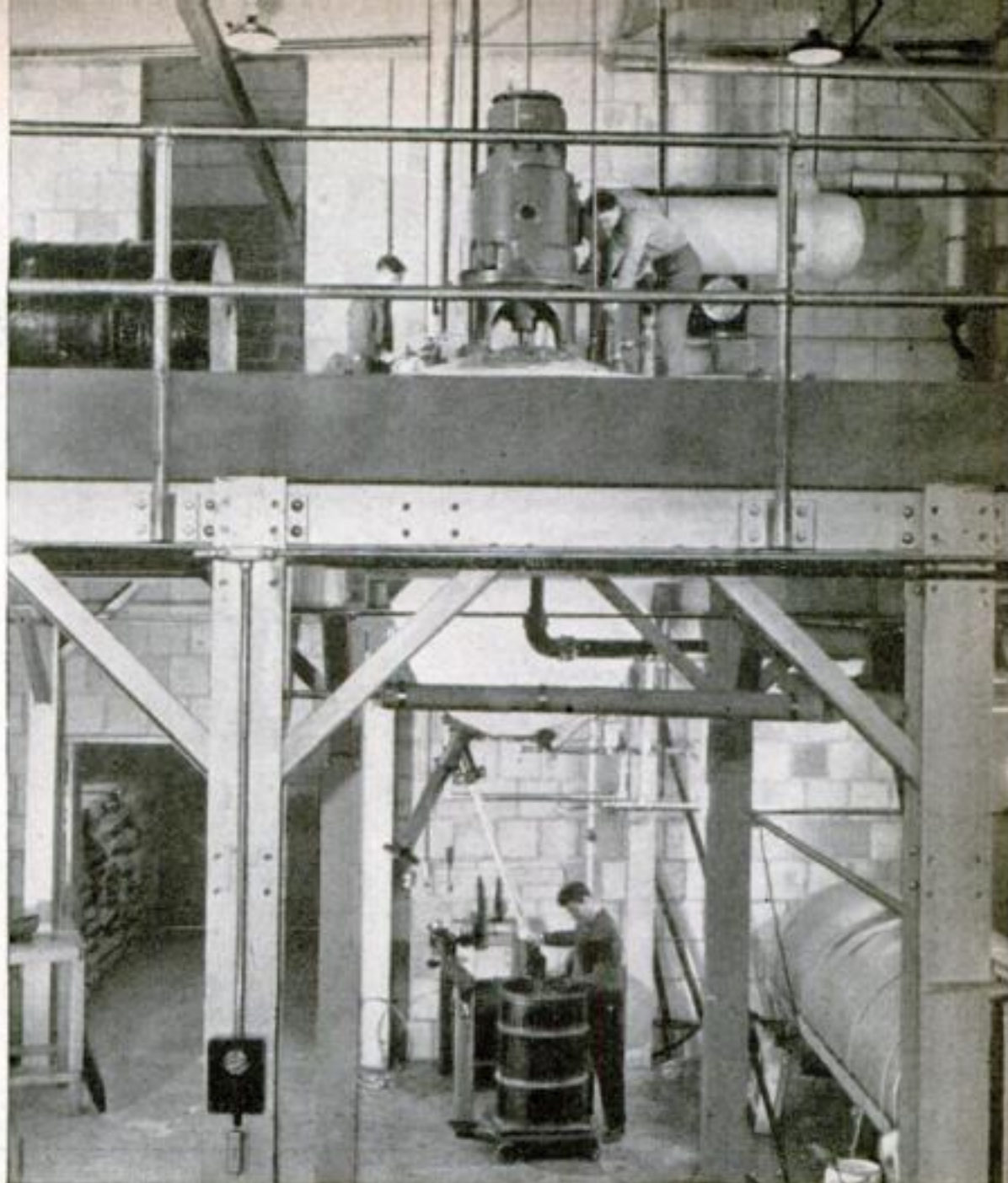
Urea and formaldehyde, with other ingredients, go into a 1,000-gallon kettle atop this two-story layout

weatherproof plywood—which has opened up whole new vistas for the prefabrication of houses and for other industrial uses—has been made possible by the discovery of phenol resin glue, first introduced from Germany in 1933 as a special means of bonding expensive furniture. Like its close relation, bakelite, phenol glue is synthesized by a combination of phenol and formaldehyde; and when hardened, it forms a permanent bond, completely impervious to heat and moisture.

This phenol stuff, though fairly expensive, was the answer to the plywood maker's prayer, except for one thing. It would harden only under intense heat, which required the use of hot-plate presses. Even so, its acceptance has been extremely rapid. In 1936, when it was introduced, there were only 13 hot-plate presses in all the United States, using a half million pounds of resin glue. By 1940 there were 120 presses in the country, using 6,000,000 pounds. Even at a price 50 percent above ordinary soy-bean or starch-glued plywood, the demand was far above supply. Experts foresee the time when capacity will have been increased and costs reduced until the phenol-bonded plywood will not only become standard for indoor and outdoor use, but will open up vast possibilities for use of this light, strong, fabricated material. Promising experiments are being made, for instance, in molding airplane bodies and wings out of wood veneer and phenol glue.

But whatever the miraculous virtues of phenol resin, it is obviously useless away from a shop where heat can be applied; and that is where the new urea-formaldehyde resin comes in. Spurred by the appearance of a glue superior to casein, Leicester went to Germany in 1935 for the Casein Company and came back with the formula for the urea glue, a close cousin of the phenol product, which had the great advantage that it could be worked cold.

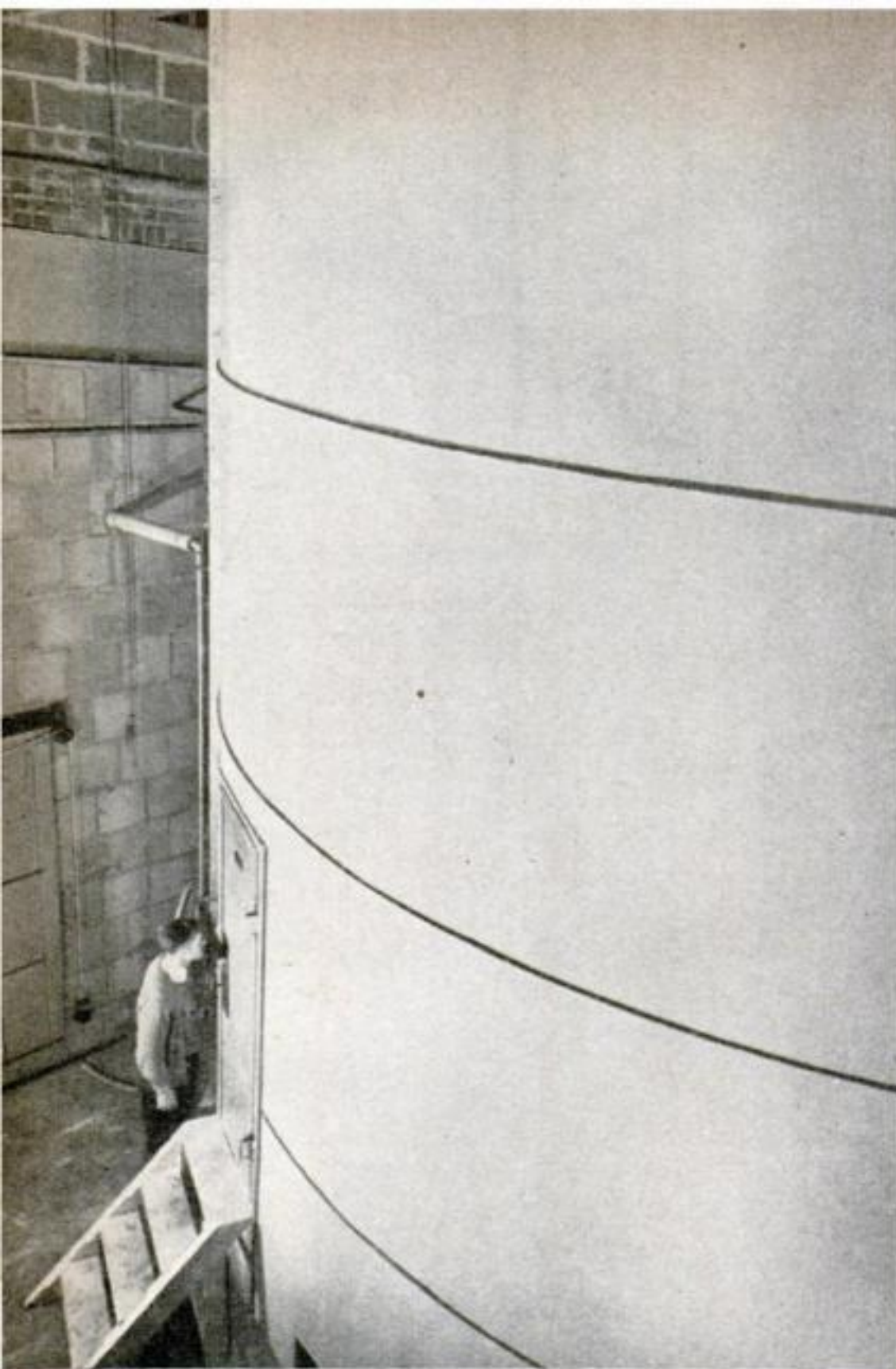
Put into production in 1937, the urea resin made rapid progress in



A vacuum is created in the kettle and the mixture is boiled at a low temperature. By appearance and other tests an operator knows when...

... the product is ready to be run off and passed through a strainer. At this stage, the glue is in its liquid form, suitable for commercial but not for small-scale use





To put the glue into handy powdered form, it is piped at the rate of 200 gallons an hour into a 20-foot silo

Here it passes through the nozzle shown below, onto a metal disk spinning at 15,000 revolutions a minute . . .



the woodworking industries. It was so strong that it could be mixed with flour as a filler, which made it as cheap to use as soy-bean glue. It did not dull tools or stain wood as casein glue did. It was inferior to phenol resin only in that it was not quite so durable. It would not stand boiling. At temperatures above 145 degrees it deteriorated. But as a supplement to phenol glue, or as a substitute where heat was not a factor, it was superior to all others.

For instance, in the dry-built construction of houses with plywood it could be used in bonding joints of the weatherproof exterior plywood as well as for the interiors. It could be used to make permanent joints in furniture, which is not infrequently subjected to the hazards of flooding, but seldom boiled. The urea glue made it possible for small shops to get most of the advantages of the phenol resin without the necessity of purchasing equipment for applying pressure under heat. At the same time, the urea glue could be used in hot-plate presses for quick setting quite as satisfactorily as could its phenol-formaldehyde cousins.

One disadvantage, however, made it impossible until now to offer the urea glue to the general public. In its usual industrial form, without application of any hardener, the glue will solidify into a hard mass within ninety days at ordinary room temperature. The shops using it have had to order in small quantities, and even then they have had trouble in hot weather. This time factor made it impossible to market the glue through ordinary retail channels, for it would harden on the shelf in the hardware shop. It is this difficulty which has now been solved, by drying the glue into an inert powder.

The Casein Company of America is a division of the great milk combine,

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the Borden Company; and its chemists, working with engineers skilled in the drying of milk, developed a method of drying the glue, which recently came to actuality in the installation of new equipment at the plant in Bainbridge, N. Y.

A visit to the Bainbridge plant is like an adventure into a brave new world of test tubes, retorts, and synthetic plastics. The three dozen workers in the research laboratories dominate the place, outnumbering factory workers four to one; for these modern chemical processes are simple, once they are developed.

The main equipment for making urea resin is a 1,000-gallon reacting kettle of gleaming white metal, incased in a steam jacket. Into this sealed tank is run formaldehyde, derived from West Virginia natural gas by the Hayden Chemical Company. The other main ingredient is crystal urea, synthetically manufactured by Du Pont. Minute quantities of other ingredients are added, as catalytic agents; nobody tells you precisely what they are. A vacuum is drawn in the kettle, and the mixture is boiled at low temperature.

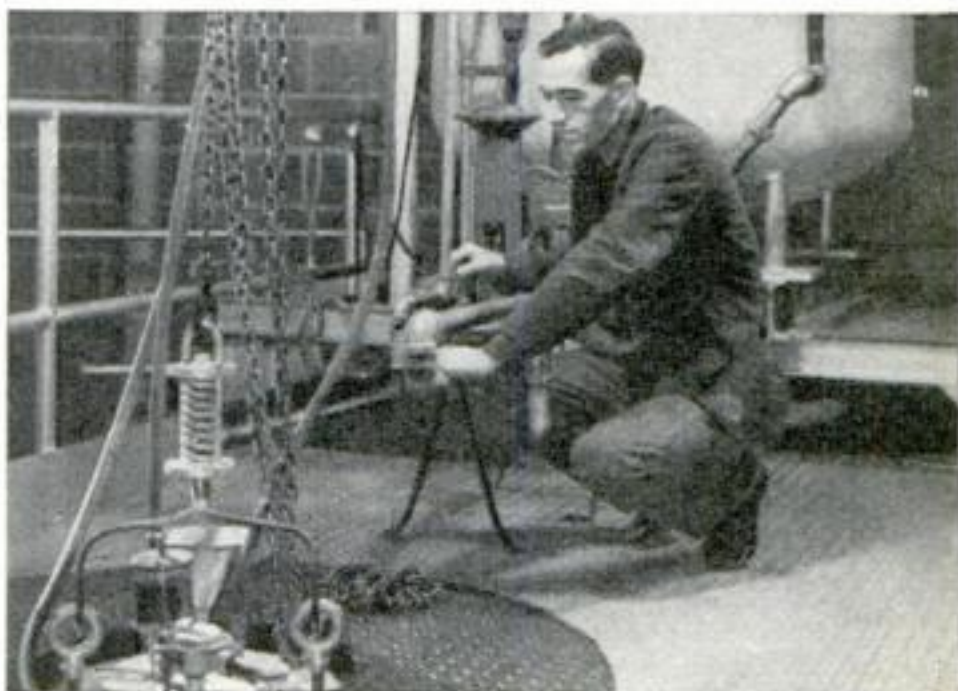
The kettle is lighted inside, and watching through a port at the top is a chemist who has at this moment a very tense responsibility. By appearance of the surface and other tests, he must watch for just the right moment of resinification. One mistake or careless slip may turn the whole mass into one hard casting of glassy resin. At precisely the right moment, the product is run off and quickly cooled. At this stage it is liquid glue for commercial use, a thick solution in water.

To make the new powdered Cascamite, the glue is piped to a silo, 20 feet in diameter and 20 feet high. There it pours in at the top, 200 gallons or 1,500 pounds an hour, onto a small disk rotating at 15,000 revolutions per minute. This disk, eight inches in diameter, with a series of small fanlike blades around its circumference, blows the glue into a fine mist which immediately encounters a blast of superheated air. Instantaneously dried into dust particles, the resin settles through rapidly cooling air, which is down below boiling point at the bottom of the silo. Blown out

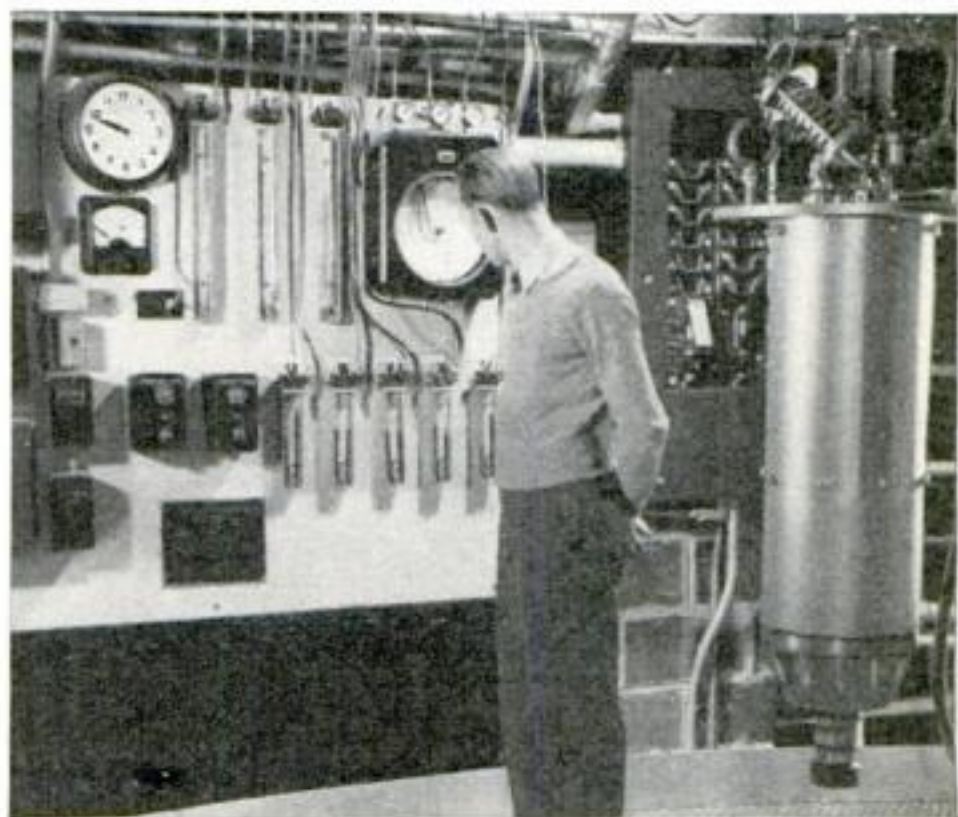
Temperature, regulated from this control room, has a big part in the drying process



Adjusting the spray head inside the drying chamber. In the views on the opposite page, it was outside the silo



Here we see the top of the drying chamber with the spray head in place. Operator Chas. A. Shields is examining it





Blown out of the silo over water-cooled screens, the dust is fanned into collectors and sealed for storage



of the silo over screens chilled with ice-cold water, the cooled dust is fanned into dust collectors and immediately stored in air-tight containers.

In this dry state, chemical action in the resin is arrested until it is again dissolved in a small quantity of water. It is so inert that it can be mixed in the can with a hardener (an acid-forming salt of ammonia) and it will remain in perfect powdered condition unless it is allowed to absorb moisture from the air. This addition of the hardener makes it possible to mix and use the packaged glue in one simple operation, and speeds up the glue so that it sets within two or three hours of its application. It needs some days of seasoning to attain full strength and waterproof qualities.

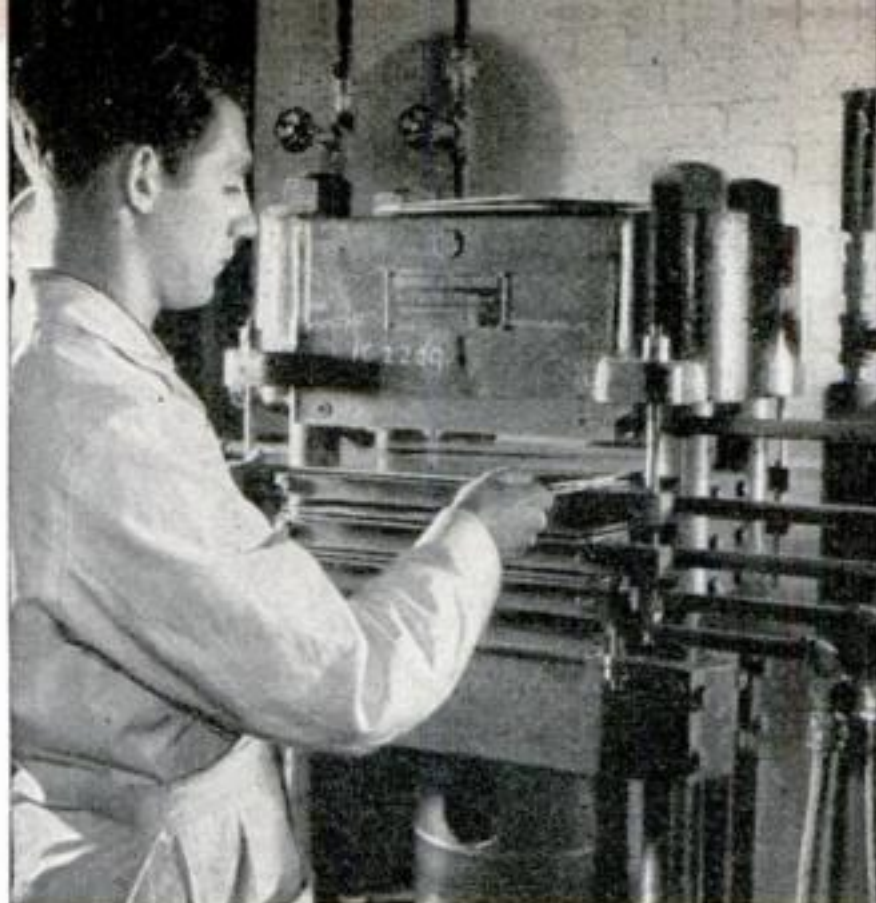
Offered in cans from 10 to 85 cents (for a pound) Cascamite is about twice as expensive as casein glue for surface covered, for it is heavier and takes less water. Nevertheless, its makers are confident that it will cut rapidly into the sales of their Casco, especially for the gluing of wood and other porous surfaces. Even resin glue is not much good for bonding two non-porous surfaces, such as glass or china.

Though their business was founded on milk curds, the Casein Company people are not at all dismayed at the prospect that resin may displace casein for gluing purposes. For years they have been making millions of pounds of soy-bean glue in their Seattle plant for the plywood industry, and recently expanded that plant for the increased production of phenol-and-urea resin. Other companies—the Bakelite Corporation, the Resinous Products Company, and the Plaskon Company—are making resin glue, and that is the competition to be met.

But it is doubtful whether any of these companies will venture soon into the business of providing resin for the use of the average household. That is a specialty of the Casein Company, which it practically stumbled into twelve years ago and which has grown until its packaged Casco amounts to nearly a million pounds a year, almost a quarter of its casein glue production.

The value of casein glue first became really apparent during the first World War, when it was used in mak-

Laboratory workers, like these testing the liquid resin, outnumber factory workers in the Bainbridge Casco plant by four to one



Placing test panels in a hot-bed press like those used in commercial gluing, to check on the product



Mold cultures prepared on potatoes and bread test the resistance of the resin bond to moldy growths

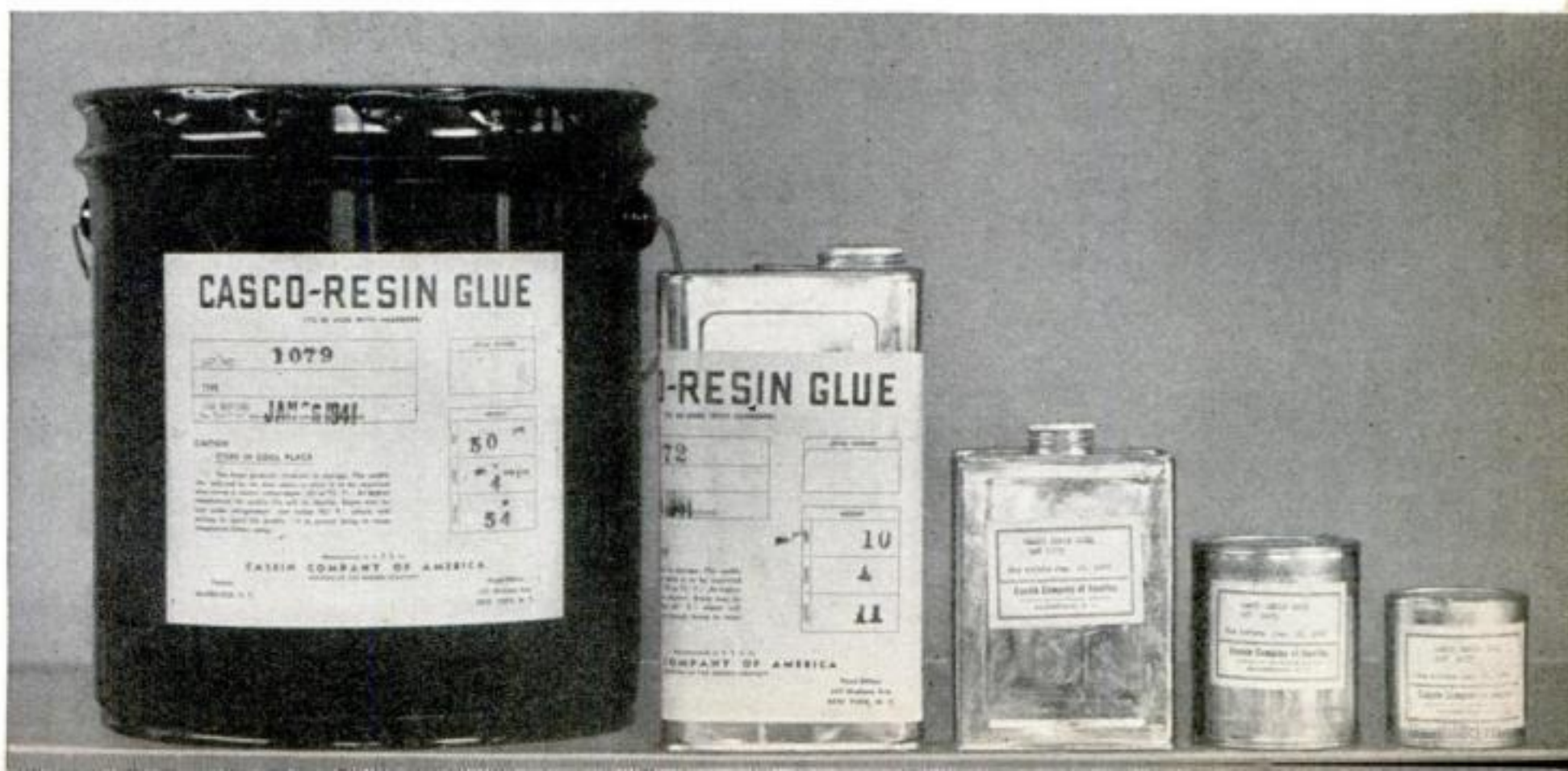
ing plywood for airplanes. The Casein company, mainly interested in providing a base for paint and paper-coating, built up its glue business after the war. But it never thought of going into the package trade until 1928, when people became a nuisance, coming into their main offices in New York, seeking to buy a pound of the casein glue which was being sold to industry. To get rid of the nuisance, Leicester got a neighboring hardware store to take a supply of one-pound packages, which soon was turning over so rapidly that the stuff was put in labeled packages. As the word got around among craftsmen and amateur woodworkers that it was possible to buy the kind of glue used in industry, other stores began asking for it.

A great light began dawning on Leicester. "Can it be possible that people really buy glue?" he asked himself incredulously. Exploring the retail market in person, he soon found that the only glue easily available to the average buyer was liquid fish glue, which was convenient but lacking in many

of the properties required for strong, waterproof work. He bought many samples of animal glue in bulk, usually getting quite incorrect directions for its use from the hardware-store clerks.

As a result of these explorations, Casco was offered seriously to the retail trade generally, and rapidly casein glue became a standard bit of equipment for the household tinkerer. Now that its makers offer a product which they consider superior, there seems no doubt that it will have an eager market.

But the individual handy man's use for the stuff may well be only a small part of its future use. Factories will continue to use liquid resin glue, because it is cheaper; but for small jobs, by providing a joint material comparable in quality to the hot-plate plywood, in conveniently small quantities, the possibilities seem very large. They are, anyway, if you believe the prophecies of the plywood fanatics about the future of resin-bonded panels in all kinds of repair and construction work.



Live Steam



TODAY more than 2,000 men and boys in the United States are busily constructing miniature steam engines of all kinds, ranging from accurate scale-model locomotives to engines for miniature industrial plants. One of these locomotives recently whisked eight husky men around a circular track at a 20-mile speed. Another model completed not long ago was a working reproduction of the first Corliss steam-plant display at the Philadelphia Centennial in 1876.

These model builders are members of the National Association of Live Steamers. They are rapidly reviving the old hobby of constructing working models which depend on steam for their motive power. The Association has local units throughout the country, and live steamers gather at regular meetings to demonstrate new models and check up on new tricks of the trade.

One of the most active groups of the association is the New England Live Steamers Club. It has 56 members who boast a combined rolling stock of 36 engines, 14 flat cars, five hopper cars, a sand car, and a dynamometer car that is used for testing the power of their locomotives.

To become a member of the National Association a model builder has only to begin construction of a working steam model and notify the organization in care of Lester Friend, Danvers, Mass. To remain in good standing, however, members are expected to make their models perform when they are completed.

Beginners interested in locomotive construction are advised to use a scale of three quarters of an inch to the foot, and start with the plans of a simple model such as a 4-4-2, which has four wheels under the pilot, four drivers, and two wheels under the cab, or an 0-6-0, with six drivers. The most popular types are the Pacific, Atlantic, Hudson, and Mountain locomotives. Costs run from \$20 for a simple Tom Thumb, popular

with boys, to several hundred dollars for a large-size freighter.

Some model steam plants can be turned out in a few weeks, but many dyed-in-the-wool live steamers think nothing of taking several years to complete a precise job. Dan Kugler, a Los Angeles jeweler, recently finished, after five years of work, a complete train 90 inches long. Working with an enlarging glass, he bored 18,000 tiny holes and

pounded in 18,000 rivets, mushrooming the head of each with a doll-size hammer.

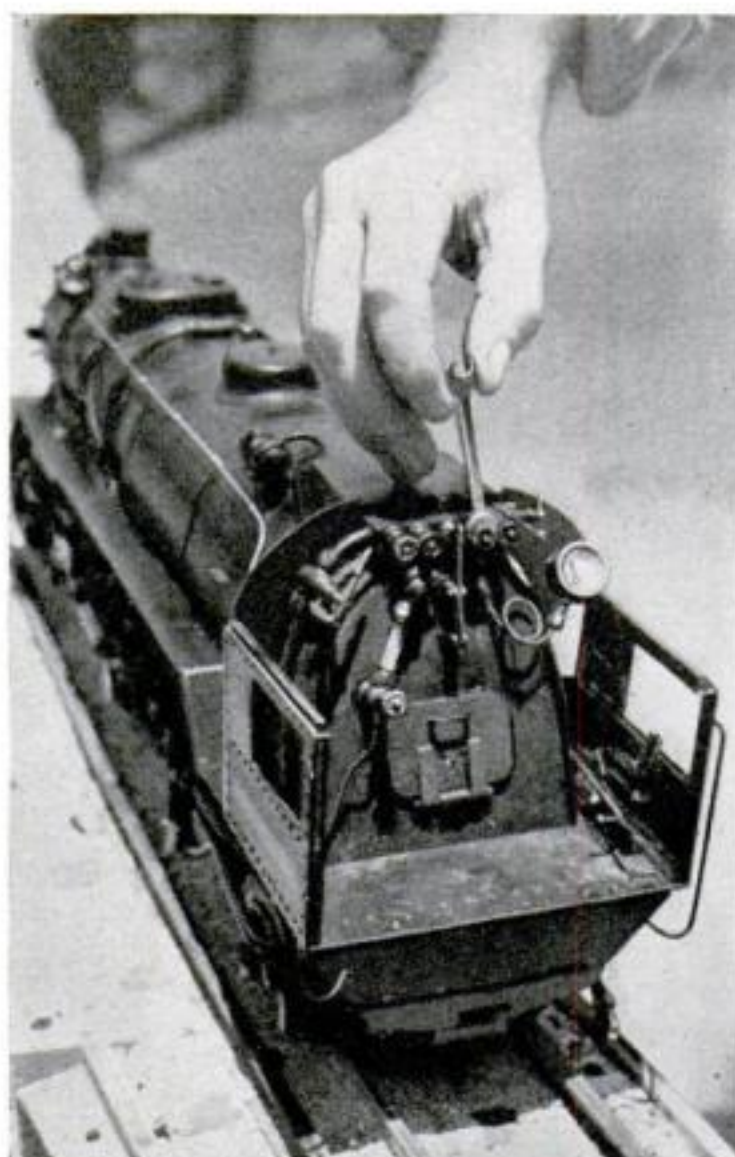
Noah Blough, an Illinois gadgeteer, has different ideas. He goes in for mass production. Working with what he termed "raw materials and junk," Blough turned out his first job, a small stationary engine, a few years ago. Since then he has polished off working models of a locomotive, a steam traction engine, a two-cylinder marine engine, six more stationary engines, and a steam-powered speedboat.

George Hartness, of New York City, admired the old Case tractor of a generation ago. Unable to obtain plans, he secured pictures from an old catalog and

went to work. After 1,500 work hours he had assembled 2,135 pieces into the completed machine. It cost him \$100 in tools and materials, but a professional model maker asked \$3,000 to produce a duplicate.

The Corliss steam plant was the work of L. E. Hiney, of Sawtelle, Calif. Enthused by his mother's recollections of the original, he built his model in a five-foot building which he keeps on a table in his home. It has everything from boiler and engines down to a workbench and tools. One of the latter is a vise that Hiney believes is the smallest in the world. It is seven eighths of an inch long and weighs one ounce.

Running live-steam model locomotives is just like real railroading, one enthusiast says. "You blow your whistle, cuss the dispatcher, and dig cinders out of your eyes."

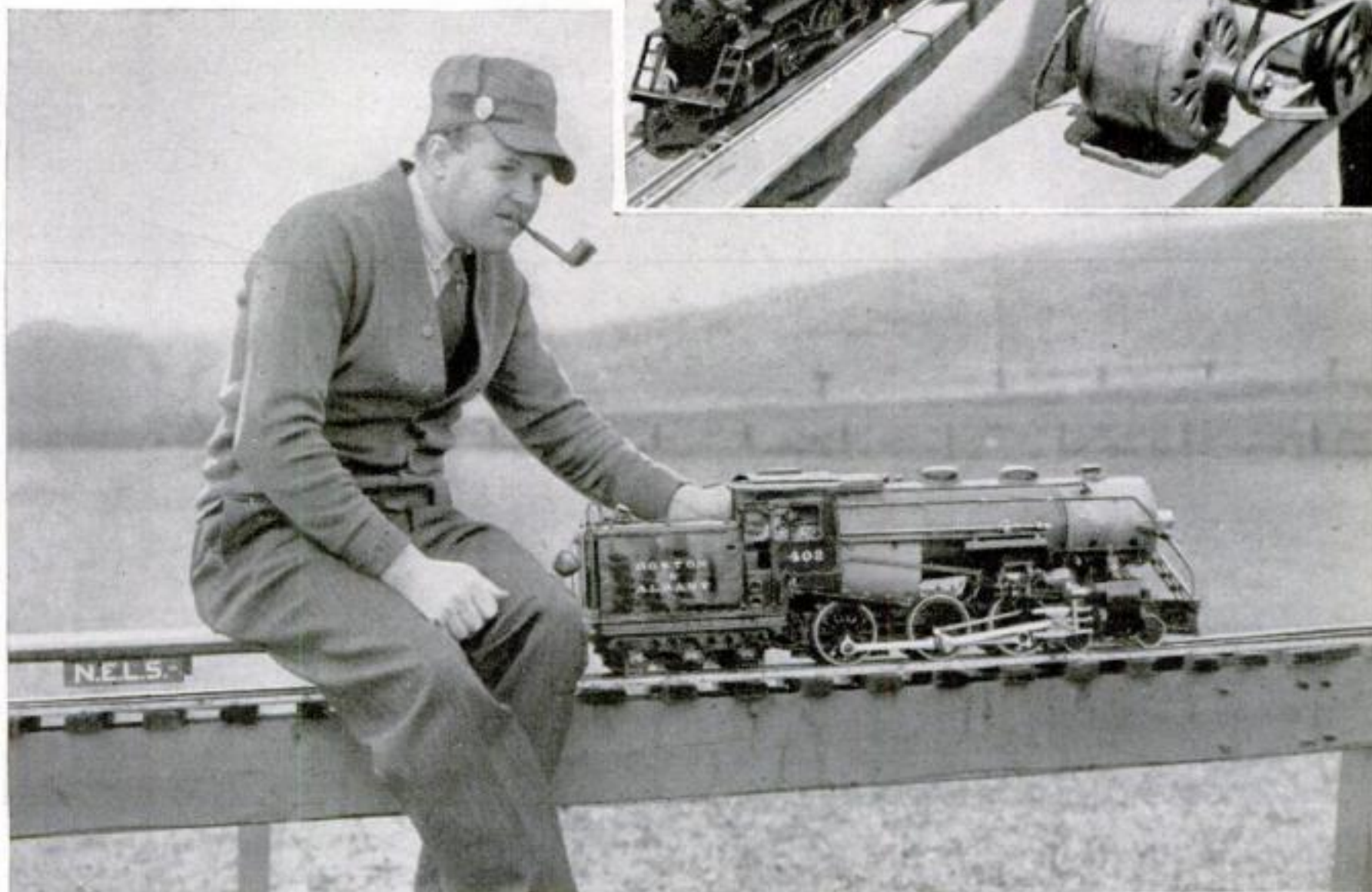
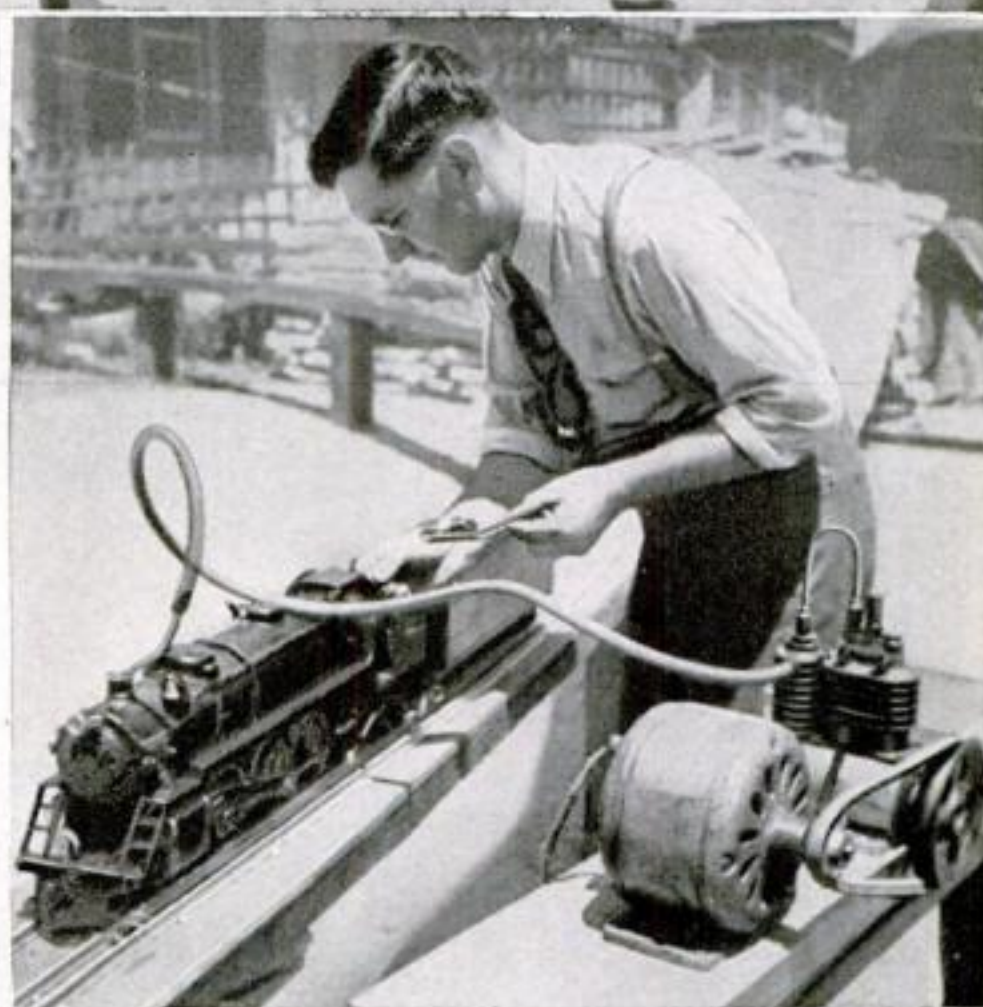


Sectional clubs of live-steam model builders run locomotives on circular tracks like this one at the home of Kyle Testerman in Los Angeles, Calif. One such club has 56 members, 36 locomotives



To get up steam quickly, forced draft is produced by sucking air from the stack with the aid of a small electrically-driven compressor. The coal fire in the fire box is boosted by directing a gas flame against the hot embers

Lester Friend, organizer of the National Association, ready for a ride around the 620-foot loop maintained by the New England club at Danvers, Mass. He is sitting on a flat car



One of these men is camouflaged; the other is not



Like a walking bush, a sniper stalks the "enemy"



Camouflage Trickery



Front and rear views of U.S. Army camouflage suits

CAMOUFLAGE—that art of concealment which was long regarded as merely a defense measure—is taking new rank today as a powerful aid to offense.

Germany acknowledged that first when she complained that British bombing planes were coated with a secret varnish that made the ships hard to see under the glare of searchlights. Proof just as convincing comes from the U. S. Army Engineer Board at Fort Belvoir, Va., the unit that directs the task of successfully camouflaging America's armed forces.

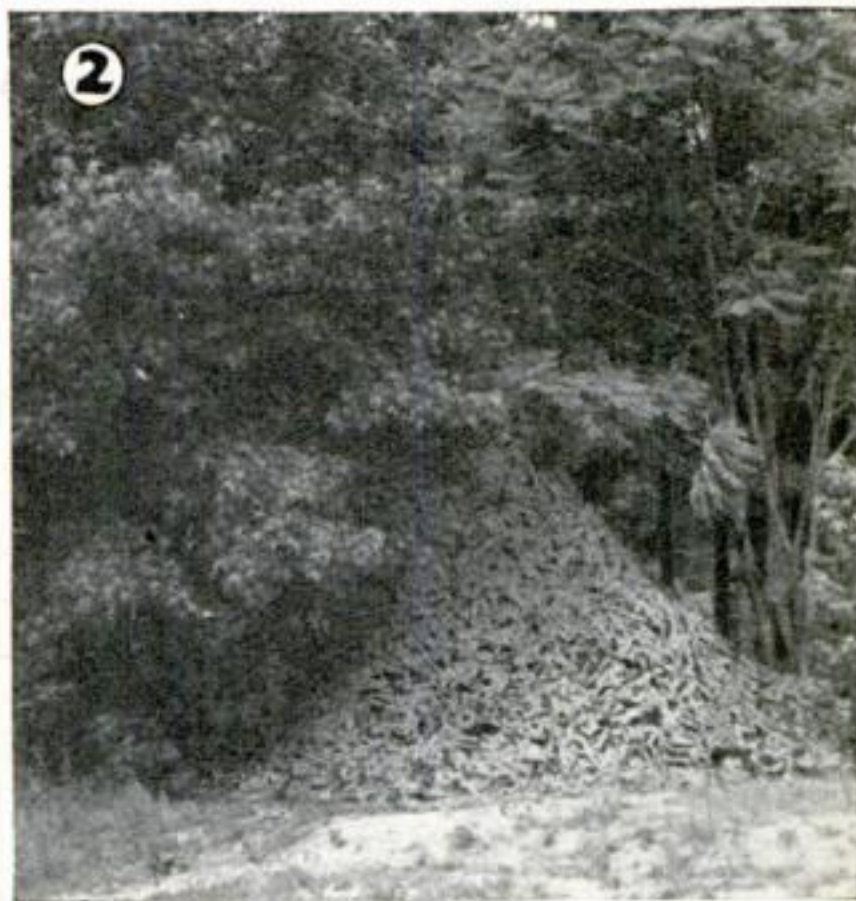
Artillerymen have offense in mind, for instance, when they laboriously hide the position of an anti-aircraft battery. They know that they have done a good job if they can fool an enemy pilot for ninety seconds, while he circles above trying to spot his target.

It is with the thought of offense, too, that the Army hides its artillery by covering guns with nets interlaced with twigs and branches; that it makes costumes of shrubbery for its riflemen; that it furnishes scouting troops with black masks so white faces will not stand out in the darkness. Always with the slogan: "Hide us from the enemy's eyes just long enough to let us strike first!"

WHAT IS HIDDEN IN THESE PICTURES? LOOK AT THEM . . .



To enemy observers in the air or on the ground, this looks like a group of ramshackle buildings in a backwoods clearing, such as might be found in any field of operations. There are no truck tracks or other evidences of military activity



Against the background of a forest, this scene would awaken no suspicions. The great enemies of concealment are sharp outlines and shadows. Protective coloring that blends into the background is useless if the object casts a shadow



You would have to be as close up as the camera was, to see anything here except a tangle of weeds and brush. Camouflage officers take tips from wild birds and animals in hiding men and military material from the hunters of the enemy



This innocent-looking leafy screen may hold a big surprise for an unwary foe. In our Army, a gun crew or infantry detachment is expected to camouflage its own position, with direction and materials furnished by special camouflage men

. . . AND THEN TURN THE PAGE TO FIND THE ANSWER

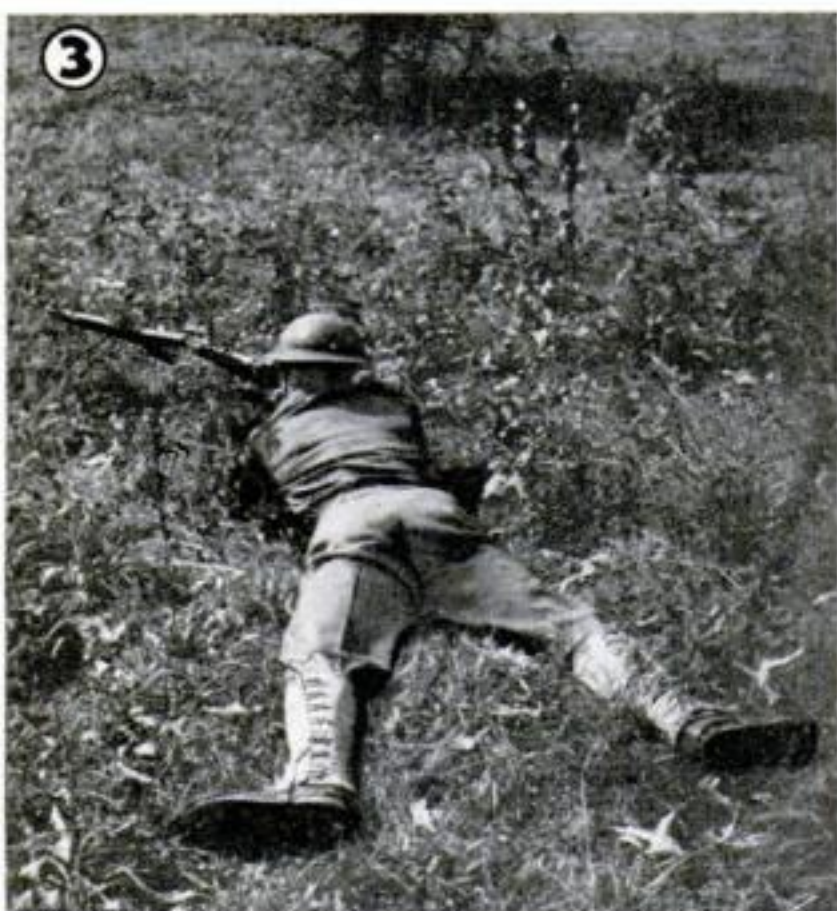
THESE ARE THE SCENES PICTURED ON THE PRECEDING PAGE...



Throwing off its disguise, the shack is revealed as the hiding place of an anti-aircraft gun. The camouflage men feel that they have succeeded if they fool a hunting pilot for ninety seconds so the gunners can get ready to give him the works



Out of that peaceful forest scene comes an army truck. Modern armies are served by such large trains of motorized equipment that it is necessary to take advantage of all natural cover to conceal troop movements and concentrations

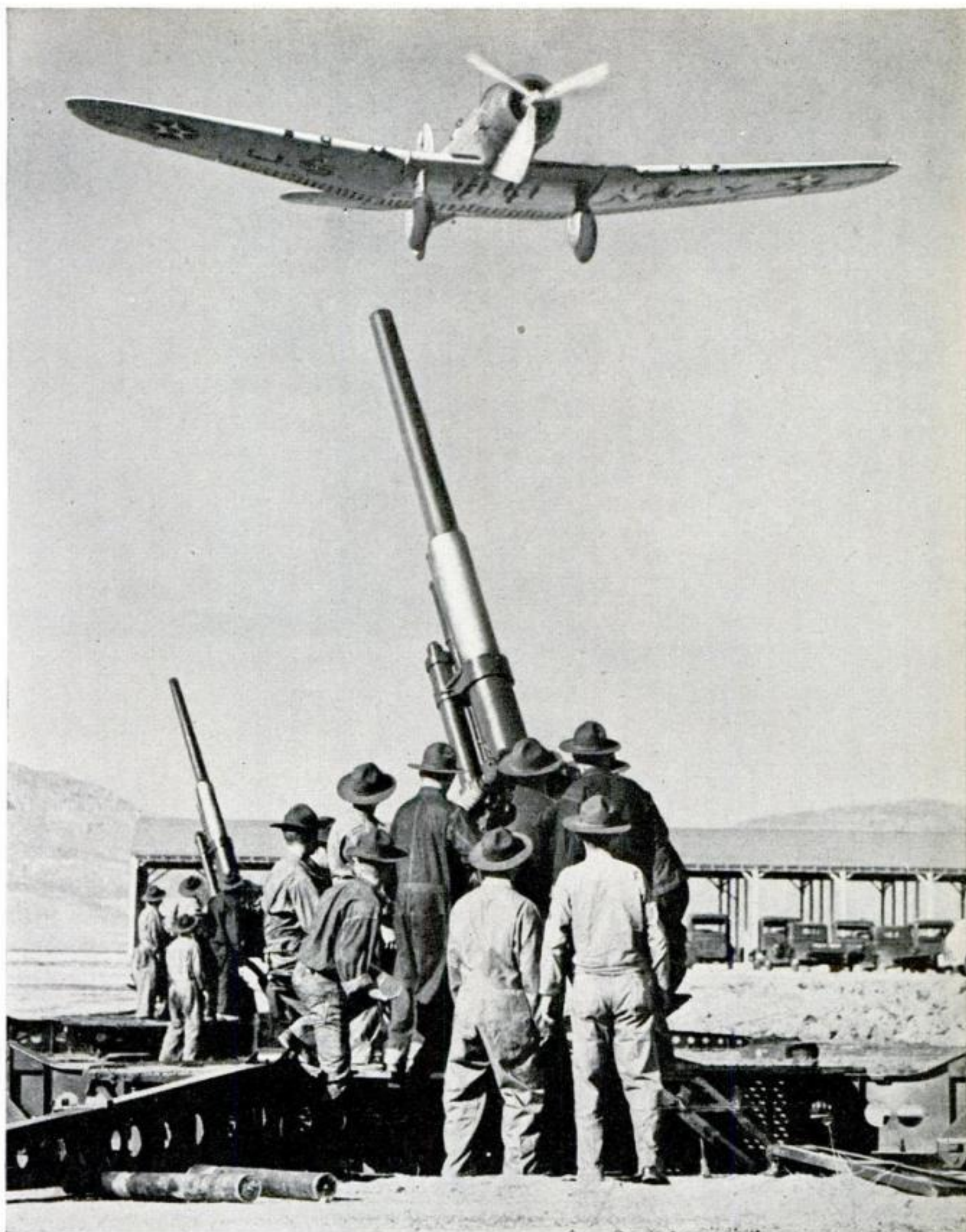


Stripped of his covering of twigs and leaves, this sniper sticks out like a sore thumb. Note how sharply his olive-drab uniform stands out in the sunlight. The secret of this kind of fighting is to see an enemy before he sees you



That innocent-looking leafy screen turns out to be a machine-gun nest. Fishnets covered with leaves hid the men and the gun in the picture on the last page. No longer a mere defense, camouflage helps the modern army to strike hard

... WITHOUT THE PROTECTION GIVEN BY CAMOUFLAGE EXPERTS



An Army plane roars above men of the 78th Coast Artillery at March Field, Riverside, Calif.

ANTIAIRCRAFT GUNNERS of the 78th Coast Artillery and other units in training at March Field, Riverside, Calif., have plenty of chances to practice aiming their three-inch rifles at real planes. Their 1,500-acre training ground adjoins the mile-long main runway of March Field, base of the 1st Wing, G.H.Q. Air Force, and their training is part of the first integrated air-land pro-

gram ever undertaken by the U.S. Army. In addition to the usual shooting at towed targets, and other tactical exercises with planes, the antiaircraft artillerymen are able to practice using their sound-detecting, range-finding, and "tracking" instruments on aircraft that are approaching and taking off from the field at all hours of the day and night.

Cotton Stockings

COTTON STOCKINGS are getting a thoroughgoing modernization and rejuvenation at the hands of the textile experts of the U. S. Bureau of Home Economics. The reason is twofold. The use of cotton stockings has dropped from 74 percent twenty years ago to four percent today, and secondly there is always the slim chance that some day our raw-silk supply may be cut off, and synthetic fabrics requisitioned for government use.

Several large textile manufacturers are already producing cotton hose in new patterns and weaves worked out by the Bureau's designers. By using finer threads they have been able to give the cotton a sheerness comparable to that of silk. Realizing that even in a nation facing a "national emergency" attractiveness is important, they have considered style as well as comfort and durability.

It is believed that the new methods and designs will boost the sale of cotton stockings and make America more independent of foreign textile materials.



New style, comfort, and durability are being built into women's cotton stockings by methods developed by U.S. Bureau of Home Economics experts

Portable Sun Lamp Folds To Fit Compact Case



ULTRA-VIOLET rays for home treatment are provided by a quartz-tube mercury-arc bulb in a new sun lamp which is equipped with a case for transportation or storage. Fitted with an automatic timer to prevent overexposure if a patient should fall asleep during a treatment, it is mounted in a holding stand which permits the reflector to be adjusted to any desired position for most effective use.

Readily adjustable for any desired height or angle, the new sun-ray lamp is provided with an automatic timing switch that shuts off the current even if the user falls asleep under treatment

32,000 Hobbyists *go to work for Science*

By **EDWIN TEALE**

WHEN is spring? How old is an average bullfrog? How many times a minute does a katydid chirp? What was weather like in the year 1500?

Amateur scientists, hundreds of them working in and around Philadelphia, Pa., during the past summer, have been coöperating to answer such questions. In a pioneer project made possible by a grant from the Carnegie Corporation, the American Philosophical Society—oldest scientific research organization in the country—has begun putting amateurs to work adding original contributions to knowledge.

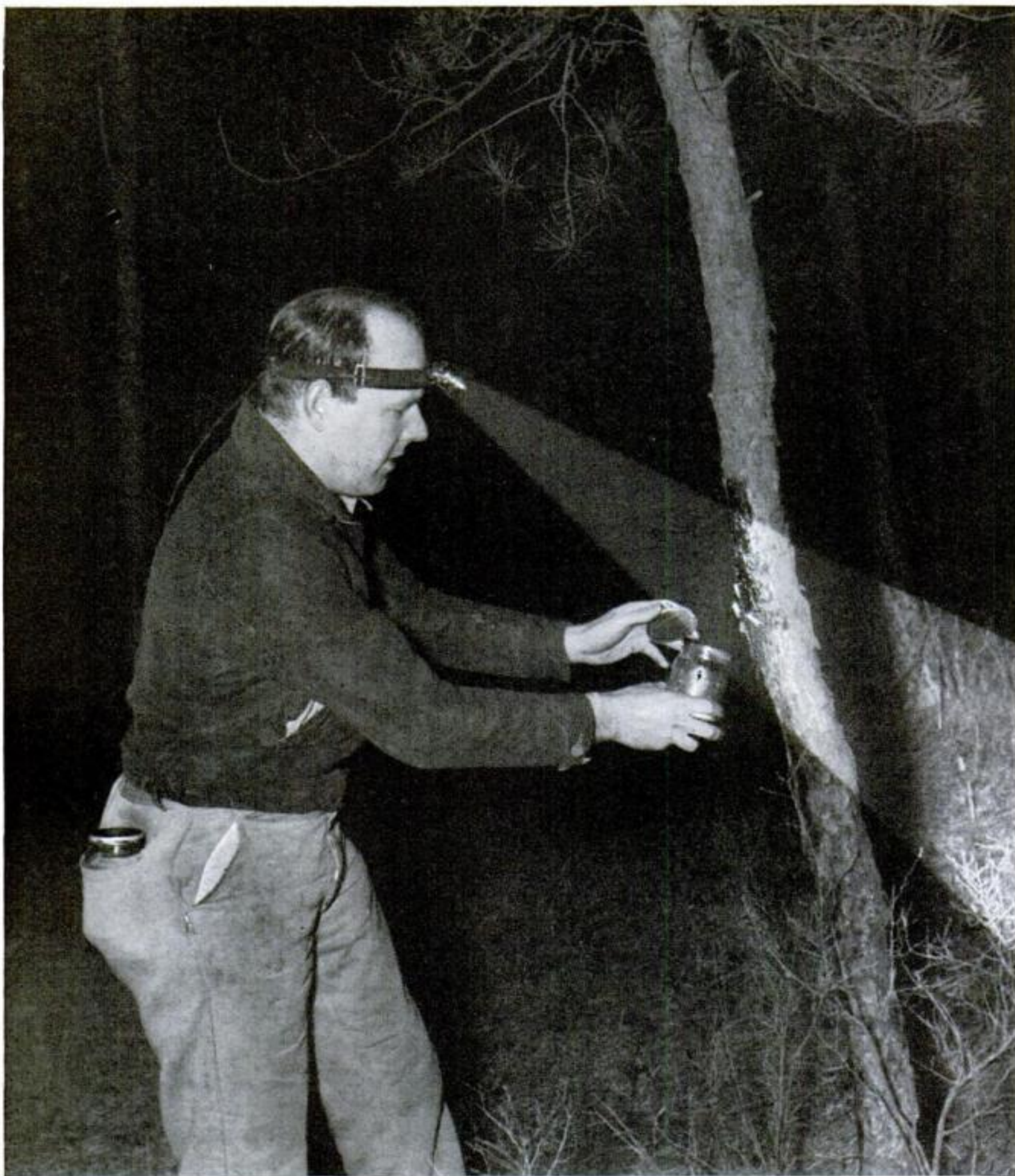
Eighteen months ago, when the project began, a survey revealed that there are nearly 32,000 scientific hobby riders in the

Philadelphia region. They belong to 287 different organizations and their interests embrace 19 fields of science. With the advice of a committee of eminent research men, including Dr. Harlow Shapley, Harvard astronomer, and Dr. Harold C. Urey, Nobel Prize winner, the director of the project, W. Stephen Thomas, has mapped out worth-while work for amateurs to do.

Those who are taking part in the program range from boys in their teens to men 85 years old. They include housewives, wood carvers, plasterers, personnel directors, restaurant counter-men, masons, printers, and even policemen. One Philadelphia real-estate man, who crosses a public park every day on his way to work, has become an authority on bird migration. A railroad lampman has recorded observations on insect life made along the right of way. And,



Wading in a swamp, amateur scientists catch turtles to mark the shells for a study of their life habits



A tempting mixture of beer, sugar, molasses, and rotten bananas helps capture night-flying moths

an insurance broker, in his spare time, has made himself an expert on the cross-pollination of flowers.

Last spring, more than 200 observers, stationed over an area sixty miles wide, recorded the first blooming of thirty species of wild flowers. Information gathered by these volunteers, working under the direction of Dr. John M. Fogg, Jr., University of Pennsylvania botanist, has thrown new light on the old question: How fast does spring move northward up the map? The records showed that the same plants bloomed six

days later on the northern edge of the area than on the southern edge—in other words, that spring advances approximately ten miles a day. The data gathered by the amateur scientists also reveals that when spring comes to a hill or mountain, it ascends toward the top at a rate of about 100 feet a day. On the summit of a 1,000-foot mountain, for example, plants begin blooming ten days after similar flowers have appeared in the valley below.

As the summer advanced, this army of spare-time workers recorded other facts

about flowering plants: when the blooms shed their pollen and when the fruit matured. By piling up evidence of this kind about 115 different spring and summer wild flowers, they have added to our information concerning the effects of temperature, the sequence of blooming, and the time interval between the opening of the flowers' petals and the shedding of the pollen. Particular attention was paid to the weather conditions at different stages of the plant's development.

The weather, centuries before these observers jotted down their notes, is the concern of another group. They are the students of tree rings. In 64 different communities in the Delaware Valley, these amateurs, under the guidance of Dr. Edward E. Wildman, formerly Director of Science Education in the Philadelphia public schools, are studying the growth rings of old stumps and ancient timbers. By noting thick rings, indicating plentiful rainfall, and thin rings, indicating droughts, they have been accumulating information about the climate in Northeastern America long before the U.S. Weather Bureau came into existence. Various successions of thin and thick rings provide patterns, or "signatures," which experts report are as distinctive as the ridge pattern of a human fingerprint. From them, the investigators can determine exactly the period at which the tree was adding a ring a year to its growth. As an additional check on long-ago weather other amateurs are seeking out old diaries and records lying in the attics of families which run back to pre-Revolutionary days. The minutes kept by the clerks of early Quaker meetings have provided another source of weather facts.

At regular intervals, a mimeographed bulletin, appropriately called "The Tree-Ring Log," is sent to all members of the group. It details the work that has been accomplished, reports additional weather data gleaned from old writings, tells of unusual discoveries, and describes any new developments in technique which have appeared.

Recently, an ingeniously simple method of recording tree-ring patterns was developed

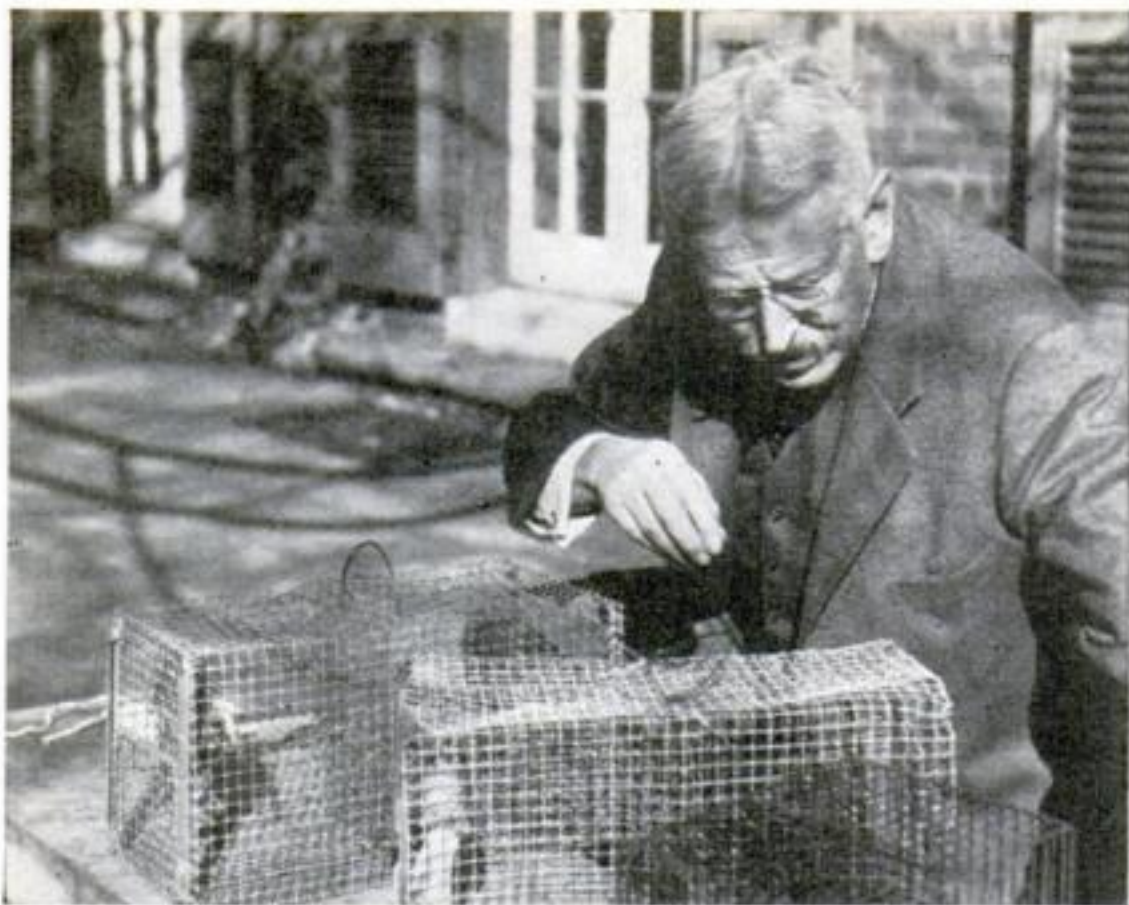


Records of temperature, taken from conveniently placed thermometers, show how heat and cold affect the insects



John Cadbury, of Moorestown, N. J., about to nab a moth

by one of the amateurs, a Philadelphia housewife, Mrs. Lynnwood R. Holmes. Instead of cutting a section from a stump or timber, a strip of adding-machine paper, about three inches wide, is fastened by means of thumb tacks to the wood. Then a soft pencil is rubbed over the paper, bring-



Bird banding also yields new knowledge. Dr. William Pepper, dean of the University of Pennsylvania, takes a bird from a trap . . .



. . . to attach an identifying tag to its leg before releasing it



Amateur botanists have been enlisted to report the dates when wild plants bloom, shed their pollen, and mature their fruit. Here Dr. John M. Fogg, Jr., University botanist, is checking the data gathered in this manner on more than 115 wild plants

ing out the tree-ring pattern just as a child traces the design of a coin. Already, more than fifty of these compact, easily stored record strips have been filed away at the Academy of Natural Sciences, and others are being added from week to week.

Among the old timbers the workers have "fingerprinted" is an oak brace from the Durham Iron Mine, the first established in America; another piece of oak from the Quaker meeting house where Benjamin Franklin rested on his arrival in Philadelphia as a young man; a piece of wood from Independence Hall; and a huge oak beam from the home of John Bartram, the pioneer American botanist—a beam that dates back to 1500 A. D., when the tree from which it came was a sapling. Recently, these tree-ring detectives have obtained a section of one of the hollowed-out oak logs laid down in Philadelphia in 1811 to form the first water mains in America. A study of the ring pattern reveals that the tree from which the log was made started growing a quarter of a century before the American Revolution.

Amateur astronomers are also busy on various projects. Last August, when the Perseid shower filled the sky with streaking fragments, an elaborate "comet census" was organized. Coöperating with Dr. Charles P. Olivier, President of the American Meteor Society, scores of amateur sky-watchers kept a record of the number of falling meteorites they saw during each hour of the night. The highest count was 70 meteorites in 60 minutes. Another group, composed of several hundred radio amateurs, are engaged in compiling "fade-out" data and "skip-distance" records. Their information, forwarded to Dr. Serge A. Korff, of the Bartol Research Foundation, is expected to prove of value both to radio engineers and physicists.

While these two groups are

turning their radio dials and peering through the eyepieces of their telescopes, amateur naturalists, led by Roger Conant, Curator of the Philadelphia Zoological Gardens, and Charles E. Mohr, of the Academy of Natural Sciences, as coöperator are tagging frogs, marking turtles, banding bats, and observing the habits of other wild creatures. In the Tinicum marshes, near the site of the old Hog Island shipyards, Ralph B. Lutz, an oil-refinery engineer, and a group of friends spent summer nights attaching waterproof tags to captured frogs. They marked as many as forty frogs a night. While one member of the party wielded an insecticide gun to keep off mosquitoes, the others caught, tagged, weighed, measured, and released the animals. Over a period of years, such tagging operations are expected to reveal new facts about the lives of these wild creatures: how far they travel, how long they live, what is their rate of growth.

Night operations of a different kind kept two other amateur scientists busy during August and September. They spent their evenings painting the legs of katydids with bright-colored lacquer. By marking individual insects in this way, the research workers—a mailman and his next-door neighbor, a student-druggist—were able to study different katydids and note the variety of plants they feed upon, the range of their activities, and the effect of temperature upon their singing. Next summer, they plan to extend these observations and accumulate data on the number of times a minute the insects repeat "katydid" under varying conditions of humidity and heat.

By painting tree trunks with a combination of beer, brown sugar, molasses, and decayed bananas, other workers have attracted night-flying moths for study and

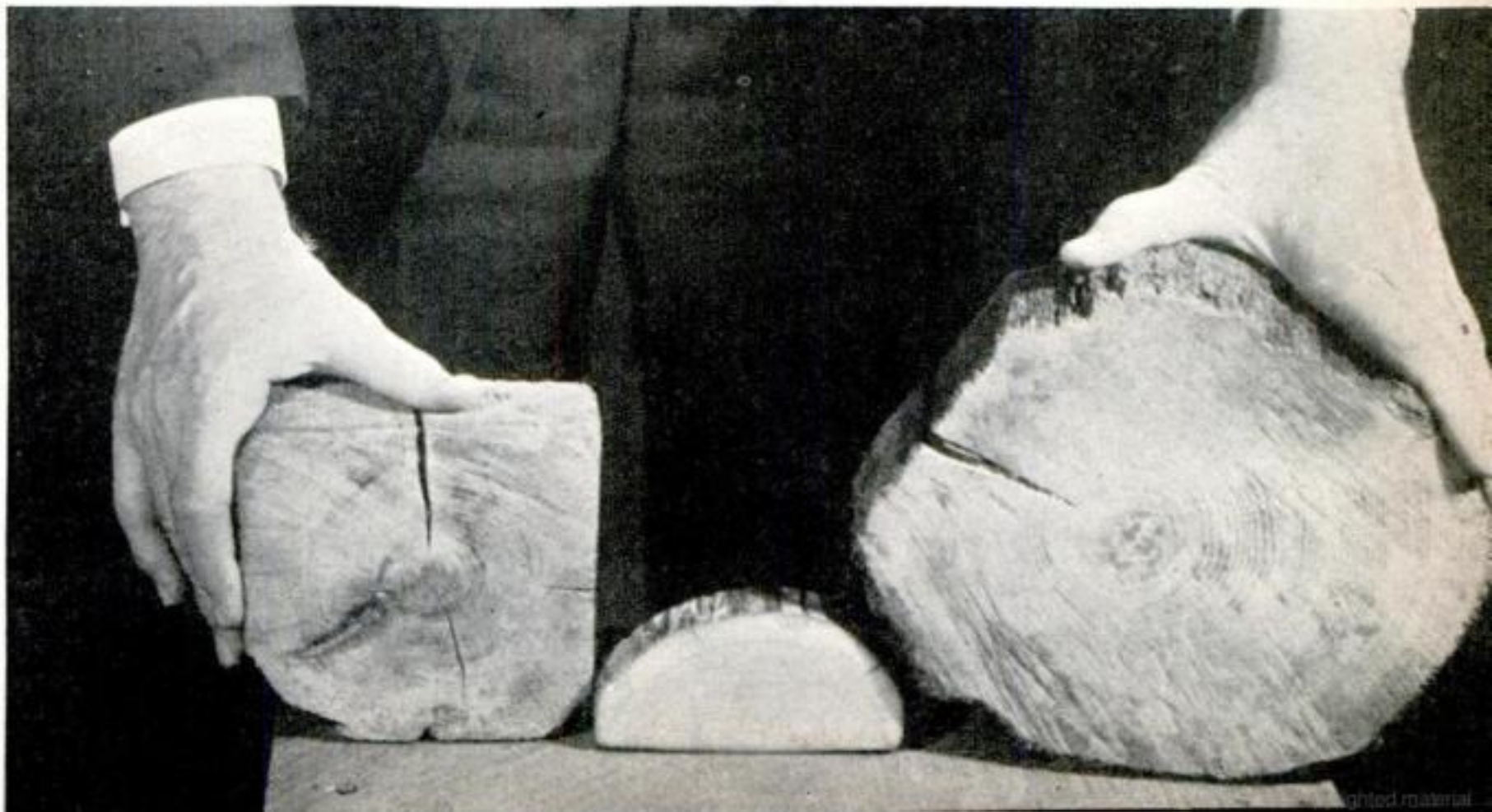


A housewife devised this method of tracing growth rings in wood by laying paper on them and rubbing with a pencil



This section of hollowed-out oak log is from one of the first American water mains, laid in Philadelphia in 1811

Below, sections of timbers from an old Quaker meeting house and from the first iron mine in America



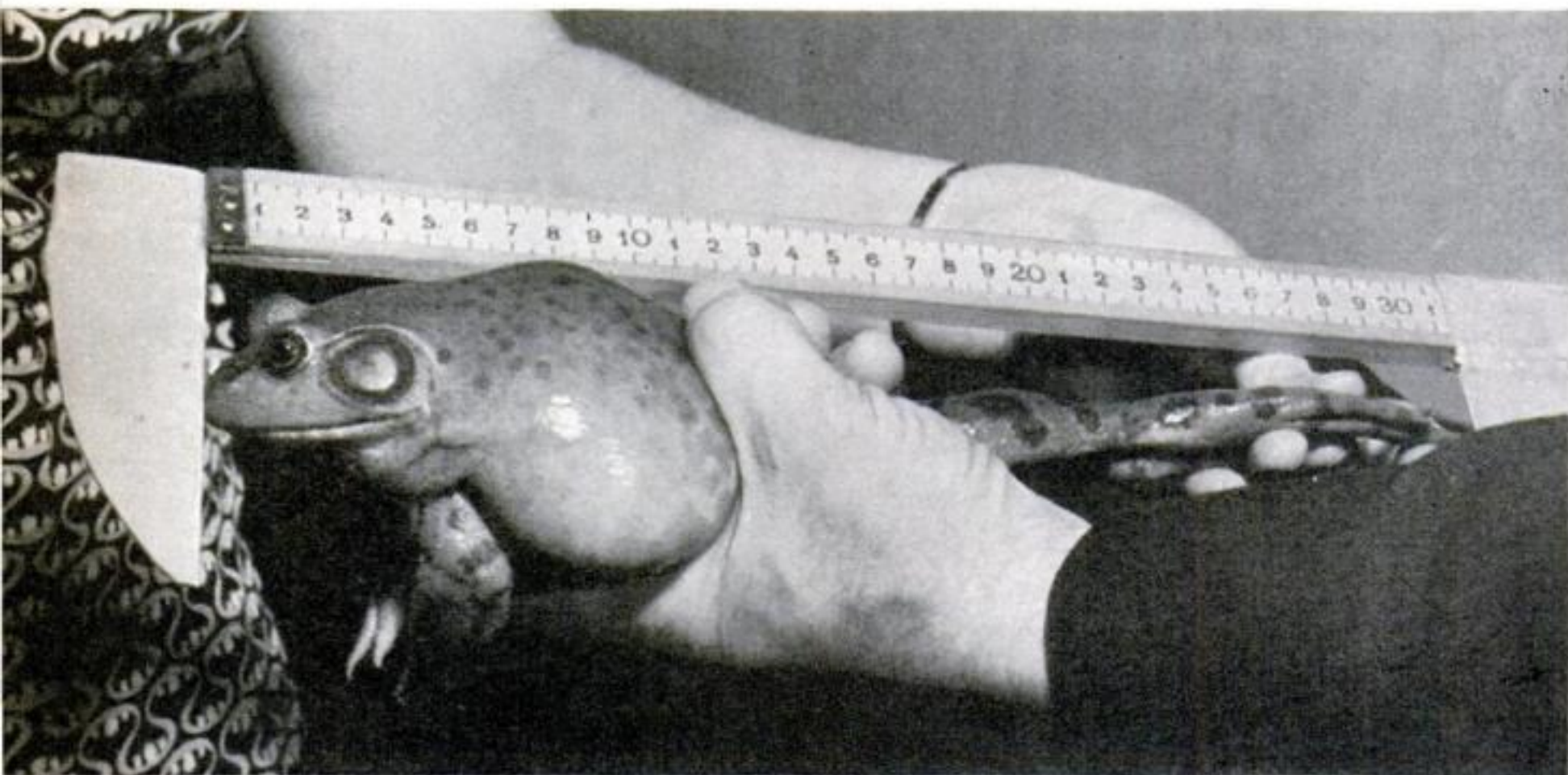
collection. Such "sugaring" draws the insects from a wide area. As they walk about the bark of the tree or sip up the fluid, they can be collected with ease. Thermometer readings are also noted on different nights as another phase of the widespread study being made of the relationship between temperature and insect activity.

Turtles, bats, and garter snakes occupied the attention of other naturalist groups. More than 300 turtles and more than 400 garter snakes were marked for future identification during the late summer months. By nicking the turtle shells and clipping scales from the undersides of the snakes' bodies, according to a code, the creatures were permanently branded. One of the surprises of this line of work was the large number of small snakes found living in vacant lots within the city. A high-school boy, Robert Hudson, discovered that he made most of his catches under pieces of discarded tar paper lying among the weeds. So he canvassed neighboring roofers and lumber yards and obtained odd bits of roofing material which he placed at strategic

points to attract these harmless reptiles.

Bat banders, under the leadership of a pioneer in this field, Charles E. Mohr, have entered caves and wriggled through narrow passes in search of their quarry. Not long ago, when workmen began repairing old abandoned tunnels during the construction of the new superhighway linking Harrisburg and Pittsburgh, Pa., the amateurs discovered a rich hunting ground. Already, the researches of Mohr's bat banders have uncovered a mystery which remains to be solved. Sixty bats were taken near a small lake. They were all males. The question which the amateur scientists are trying to answer is: At certain times of the year, do male and female bats feed at different places?

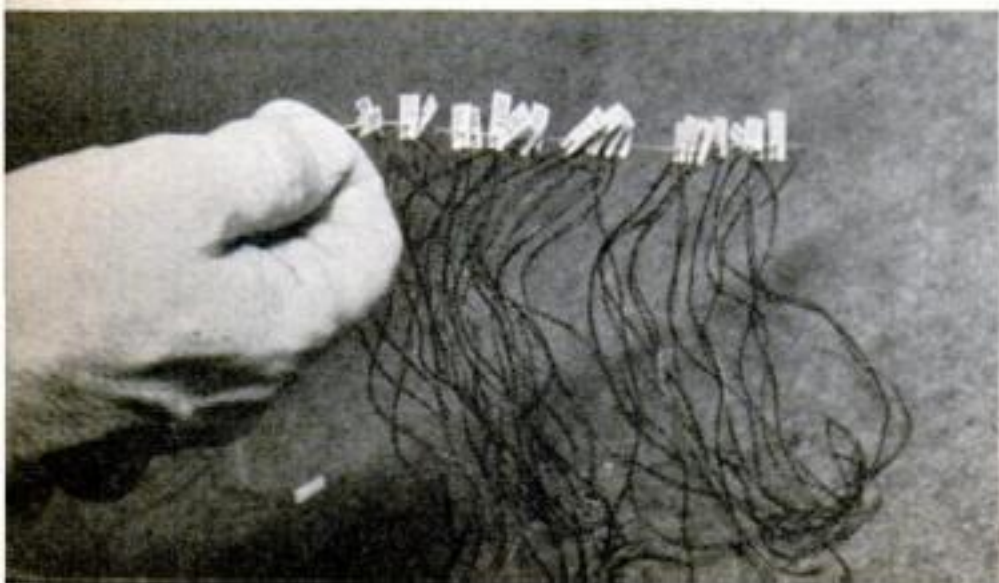
That, of course, is but one of a host of blank spots in our knowledge that the Philadelphia hobby-scientists are seeking to eliminate. In their pioneering project of combining the fun of a hobby with the worthwhile investigation of serious science, these eastern amateurs have set an example for other communities to follow.



Measuring bullfrogs is another task undertaken by amateurs. One group caught as many as 40 a night

Waterproof tags, attached by means of linen thread, were used to mark frogs after records had been made of their measurements and weight

Wearing his tag in the middle of his back, this croaker was released. If he is caught again, his travels and physical development can be checked



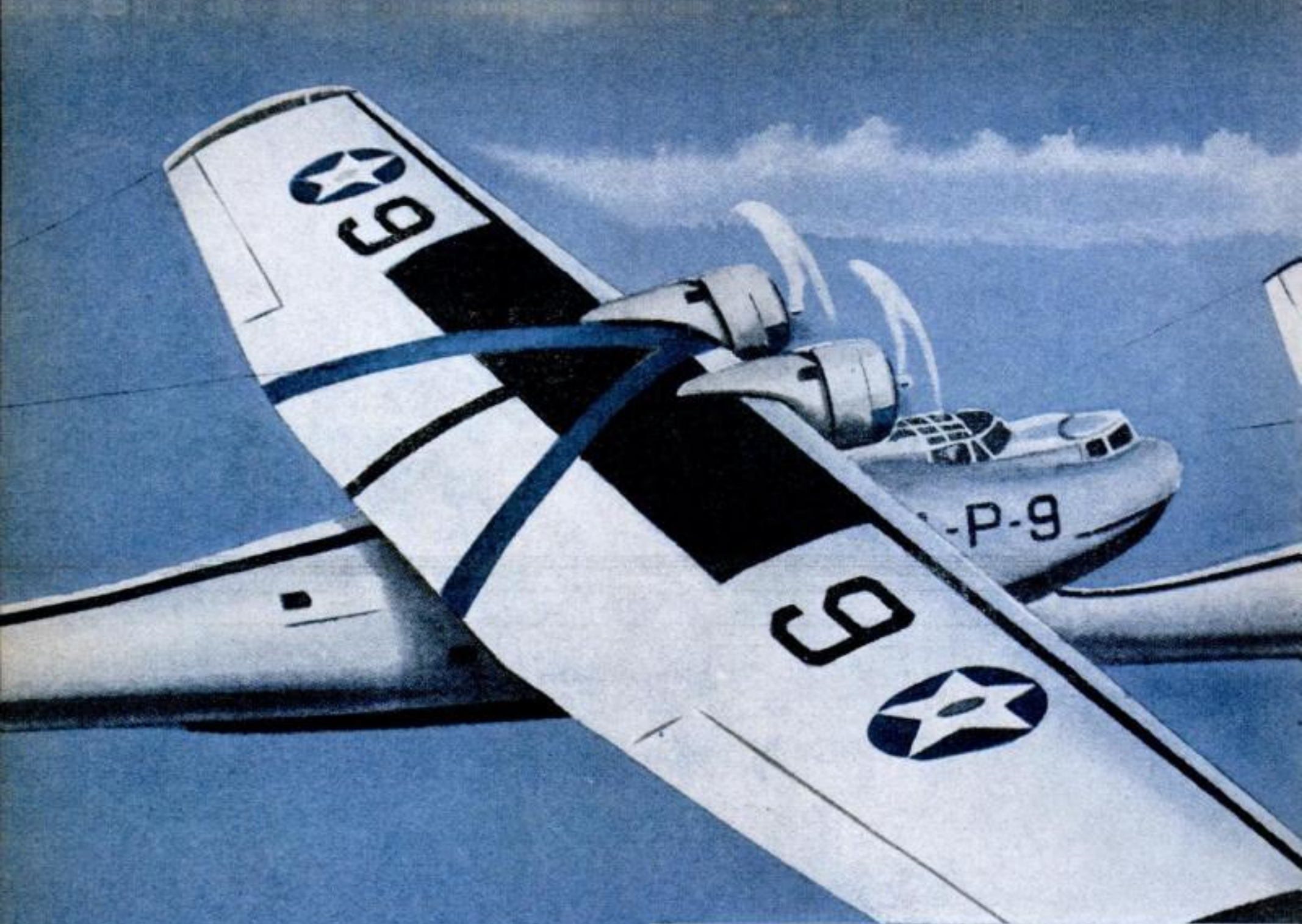


Old railway tunnels being repaired for the Pennsylvania superhighway proved a happy hunting ground for bat banders



Plucking hundreds of bats off the tunnel walls, the hunters attached tiny tags to their ears to find out how far the creatures would travel to new homes



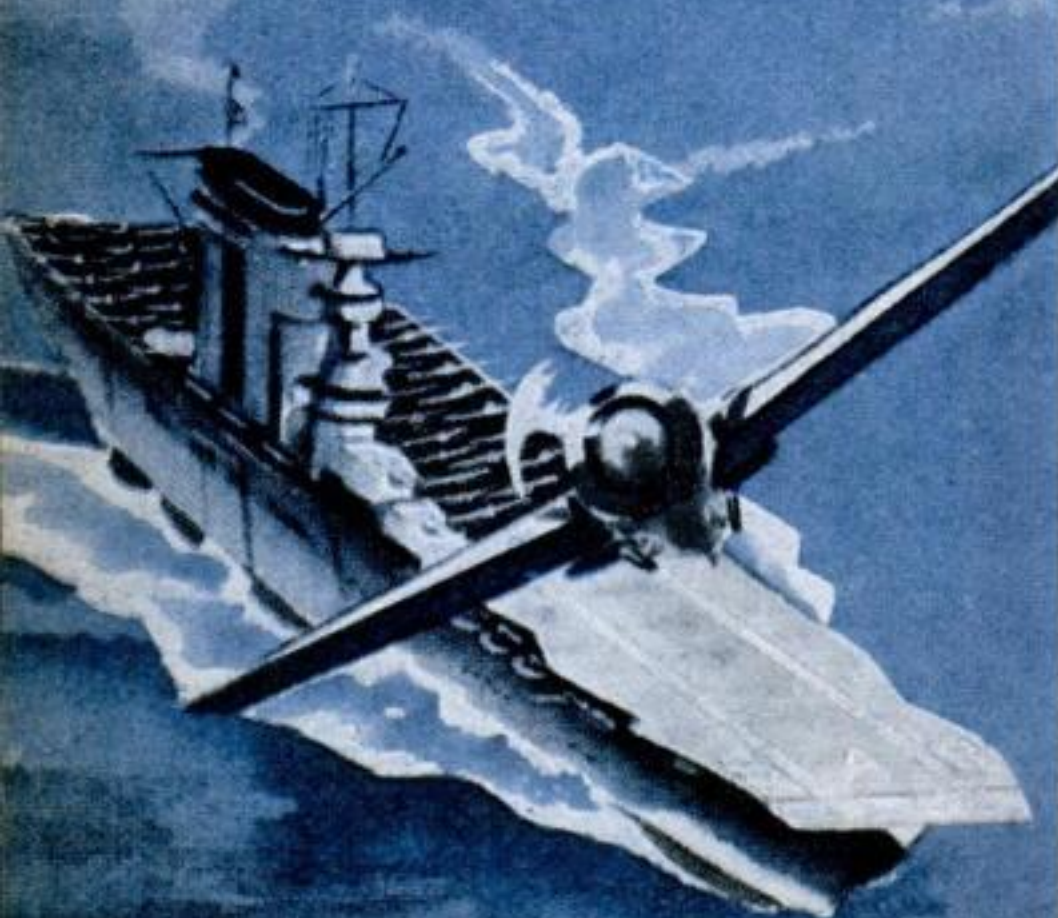


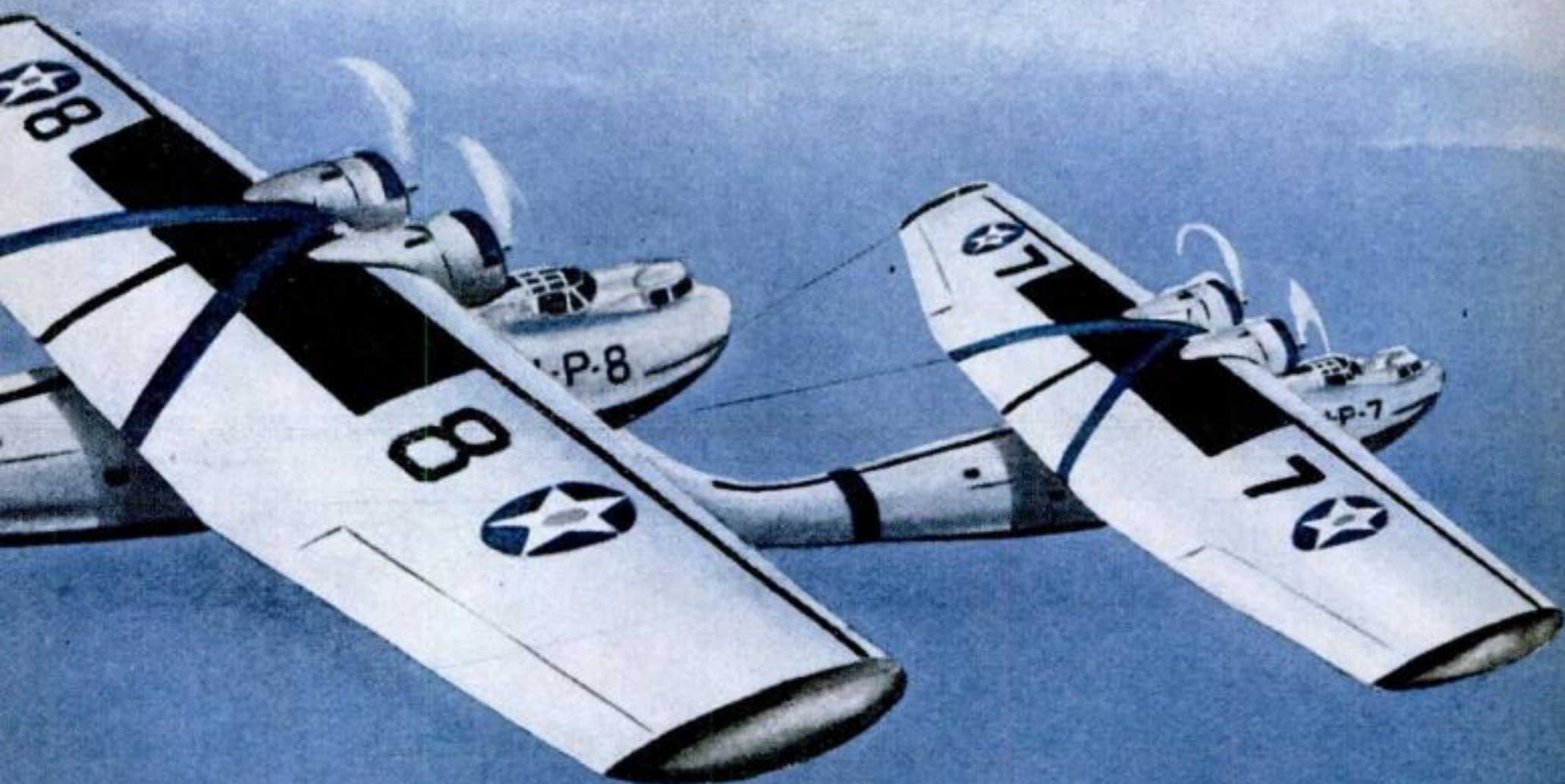
America's first line of defense against aerial attack is our naval air arm—the largest in the world—typified by these PBY patrol bombers in flight above the aircraft carrier *Saratoga*

ON OUR COVER

The planes on the cover are Grumman F4F-3 single-seater fighters, now in production for the U. S. Navy. Powered by a 1,200-horsepower twin Wasp engine, the F4F-3 has a speed above 250 m.p.h. and can carry two 114-pound bombs when used for light dive bombing.

John T. McCoy, Jr., artist-flyer who painted these pictures, has been flying since 1926 and holds a commercial pilot's license. His water-color paintings of planes are valued highly by airmen and aviation enthusiasts.





Air Defense—1941 Style

By **CARL DREHER**

THOSE of our citizens who are having the jitters about possible mass bombings of American cities from the air, or who fear outright invasion, should take a sedative and survey the situation from the standpoint of those who are to do the bombing or invading. We cannot be attacked by television, fortunately. We can be attacked only by an enemy who possesses the physical means to span several thousand miles of ocean and carry out his design. How is he going to do it?

He cannot fly over from Asia or Europe directly. For the present, there are no military planes, in numbers worth considering, capable of crossing, dropping bombs, and returning home. That sort of thing is on an experimental basis, as yet. Some of the experts assure us that such bombers will be an aeronautical commonplace in five years, perhaps less. If they are right, our air-defense problem will become far more difficult in the future. But we have time to

get ready for that situation. As an immediate possibility it is out.

This reduces the means of direct attack to surface ships and airplanes operating from surface ships, and brings the United States Navy into the picture. The Navy is prepared for any immediate eventuality. Early this year a clear-headed American army officer wrote in one of the technical military journals, "The Navy is always ready for war, the Army never." That is true in the air as well as on land and at sea. It is no particular credit to the Navy, and reflects no discredit whatsoever on the Army. It simply expresses the fact that for a country situated between two oceans, the Navy is necessarily the first line of defense. It was planned that way and the principle remains sound.

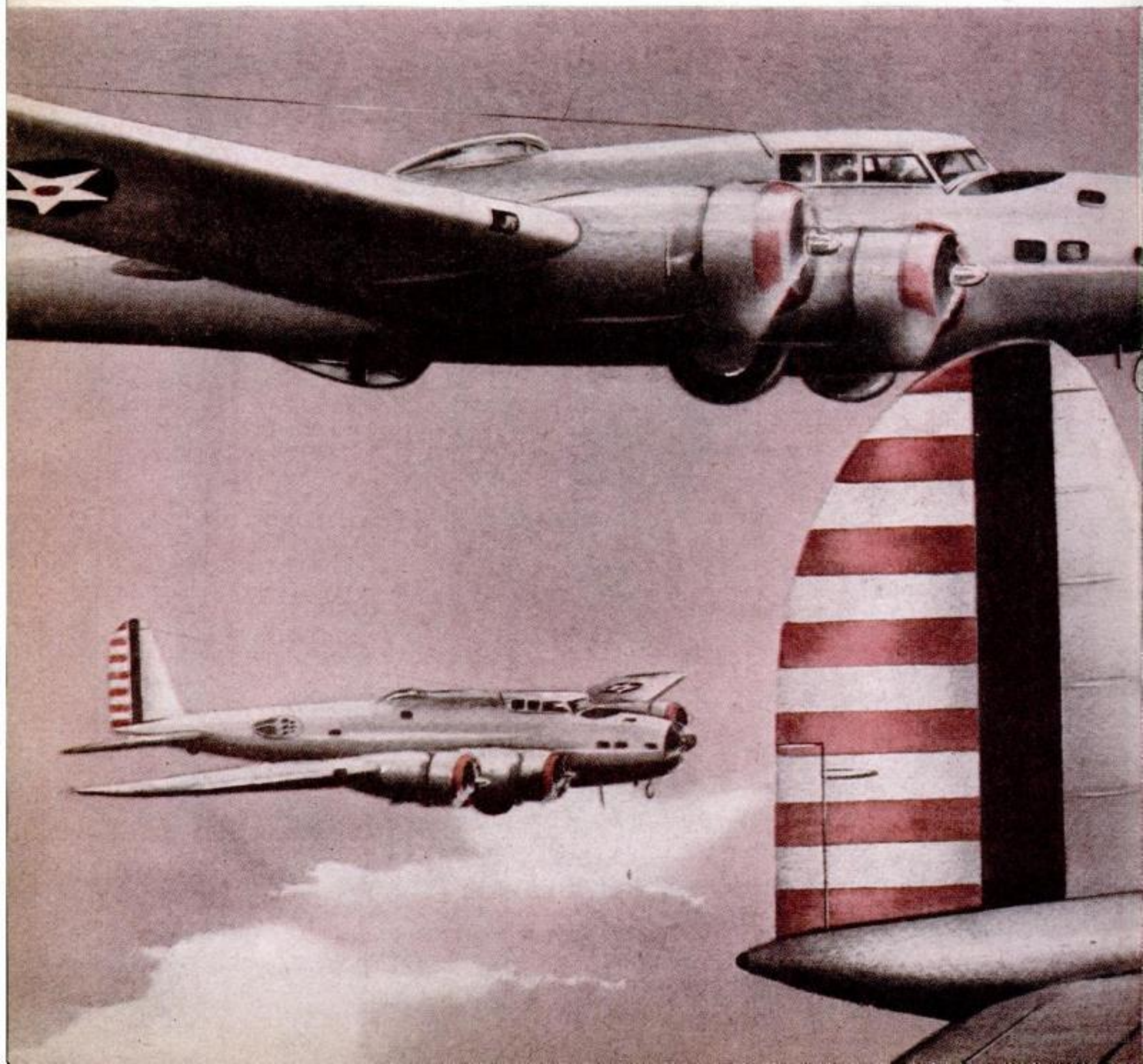
Most Americans know that the Navy has a first-rate air arm—the newsreels tell them that much—but very few know that our naval air force is not only one of the best, but the largest in the world. The totalitarian brethren know it, though, even if our

citizens don't. This naval air force, even without the support of the Army's heavy bombers, could make the high seas very unhealthy for any foreign expeditionary force which ventured thousands of miles from home to attack the continental United States. Perhaps our patrol bombers and flying fortresses can't send capital ships with heavy deck armor to the bottom, but they can certainly send them into dry dock, back where they came from. The invaders, as long as bombers are confined to their present ranges, will not have the wherewithal to inflict the same punishment on our ships.

Aircraft carriers? Yes, but an aircraft carrier does not transport many heavy bombers, and is itself in danger of being sunk by a single large land-based plane, or a seaplane operating from a tender. Nobody has very many carriers, and a navy is about as willing to risk them in enemy waters as

—well, as the British were in the Norwegian campaign, and that was only across the North Sea. We have seven carriers ourselves, two of them old but modernized, one six years old, the rest new or practically new, and their 500-odd planes can keep a sharp eye on a lot of ocean and do some light and medium bombing on the side.

Indirect attack offers better possibilities for sustained air assault on American objectives—the only kind which has military significance. This would entail the establishment of an air base or bases in the Western Hemisphere from which large numbers of bombers could take off for the Panama Canal and the United States. Granting that all the ships the totalitarians could detach, plus a good part of the British fleet if it fell into German hands, would still be incompetent to challenge the American Fleet in its home waters, such an armada might make a landing in South America,



which is not home waters for us either. But the venture is not one to be gone into lightly. A foreign expeditionary force cannot be sneaked across to the Americas. Three divisions, about 50,000 men, would require almost 400,000 tons of shipping besides the escorting force. And that would be only a beginning. Once the army was landed, a minimum of 700,000 tons of shipping would be required *monthly* just to supply them, and they would have to be supplied very well to carry on their aerial operations to the north. Nor would they be unmolested during the preparatory period, for where Pan-American airliners go, long-range bombers can go likewise.

But let the worst come to the worst: assume that the Canal is blocked before the third set of locks can be installed, and that with the bulk of the Fleet isolated in one ocean, the other coast must rely entirely on its shore batteries, antiaircraft artillery,

and aviation. The theory of coördinated naval-and-air defense for America would then rest more than ever on the massive use of the bomber against invaders by sea and air. And if all this happened before the end of 1941, while we were still short of bombers for such an extremity, what then?

A suggestion that is frequently made in this connection is the conversion of commercial planes into bombers. The United States leads the world in commercial air transport, and our factories are equipped to manufacture bombers of the same basic design, carrying T.N.T. instead of passengers. In some quarters it is asserted that, stripped and souped up, such improvised bombers could fly 300 m.p.h. at 20,000 feet, and their operating radii would be 1,500 miles with 1.5 tons of bombs, or 1,000 miles with two tons. Service flyers differ with these estimates and point out that combat aircraft should be originally designed and built to withstand stresses and loads which are not encountered in commercial flying. "You can't merely hang a bomb rack and a load of bombs on a DC-3 transport and have a military bomber," as one prominent naval aviation officer puts it.

To a detached observer it looks as if both sides were right and that they are talking of different situations. Army and navy men nowadays are technicians, and they take a technician's pride in machines—their machines. Without such a feeling they would be no good as technicians or fighters. Moreover, the officers who do the planning want to be assured that the planes in which other men are to do the flying are the best machines that engineering can produce and money can buy. That also needs no justification. But in an emergency such considerations must go by the board. In that case a few hundred or even a few thousand usable if by no means perfect bombers might be a sample of Yankee practicality on the order of the Nazis' feat in pouring out planes with short-lived engines and a minimum of instruments—planes that were far from a technician's dream, but that were ready when the Nazis needed them.

There may be no emergency of this kind. At the moment it seems remote. But while the drafting and tooling for the de luxe bombers is going ahead, the conversion idea should be put to the test—just in case.

It cannot be too strongly emphasized that the long-range bomber, coördinated with naval operations, is the key to American air defense. We have on hand about 1,500 army and navy bombers, roughly half of

From far-flung bases such as Hawaii, Puerto Rico, and the Canal Zone, Army bombers can strike an enemy far out from our own shores



which are in the medium and heavy class. We shall have more of them long before we can build our two-ocean Navy, long before we can train a large Army. With an adequate fleet of bombers we are in the position of a prize fighter with a long reach and great skill in boxing, matched against a strong, stocky opponent who likes to clinch and fight to the stomach. Why let him get closer than we can help? The results of letting him bore in are plain enough from England's experience. If one must rely on pursuit and antiaircraft guns to ward off the bombers over the streets, one may fight with superhuman courage—but the streets will still be full of wreckage afterwards. Against invading air fleets this is protection which does not protect, and which can at best win a stalemate, not a victory. The comparison is even more to the point when it comes to land operations. If we take advantage of the breaks which Providence has given us on the sea and in the air over the sea, we shall never have to use our Army to resist invasion by actual fighting on the ground. Its value in that respect will be purely psychological and diplomatic.

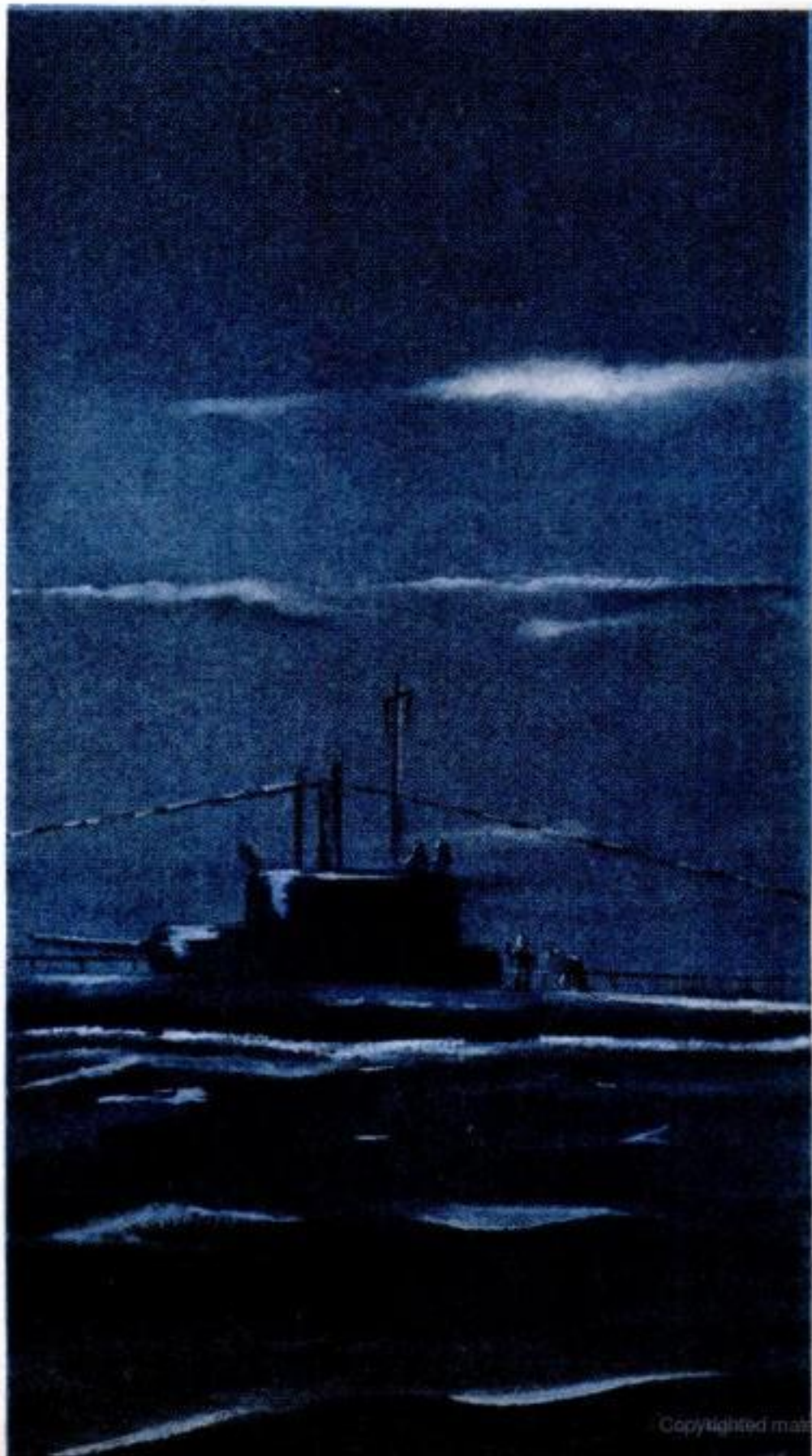
But in the air the Army's role is almost as important as the Navy's. Army bombers can fly over the ocean just as well as sea-planes, and although the latter have the advantage of operating from any point where sheltered water and a tender are available, the Army can in many cases perform long-range bombing missions with equal efficiency. The Army also has the enormously important responsibility of defending the Navy's vital bases—in effect, the Navy protects the country and the Army protects the Navy at fixed points. Far-flung bases are vital to the long-range defense plan, and everything depends on ability to hold strategic areas like Hawaii, Puerto Rico, and Panama.

This is a big country, and the Army and Navy together cannot guarantee 100-percent security. There is no such insurance in war. If we get into the war our coastal cities may be subjected to occasional hit-and-run bombing raids. One or more small or medium planes might be released from a merchant vessel acting as a tender or carrier, or even from a large submarine. On a larger scale, an airplane carrier might be sneaked to within a few hundred miles of the coast; its planes could be released to bomb cities at dusk, returning to the carrier in darkness so as not to betray its position, or the whole operation might be carried out after nightfall. It would have little military

importance, but it would have scare value; and that would be the object.

Such raids are difficult to cope with until the mother ship is located and destroyed or chased away. At least on the first attempt, it is likely that bombs could be dropped. After that an air patrol might intercept the attackers during the daytime. At night, however, pursuit defense is not very dependable. As bomber speeds rise pursuit from the ground is at an increasing disadvantage, even by day. With the bomber only 50 m.p.h. slower than the interceptor, an alert factor of 15 minutes requires a 200-mile warning if the defending plane is to meet the attacker in front of the objective; even with the best pursuit speeds and a shorter alert factor, a 100-mile warning is the least that will do. One cannot depend on getting even a 100-mile warning from the sea. Under these conditions the importance of antiaircraft guns to supplement pursuit aviation in coastal defense is obvious.

And the guns have to be big. The Army's experience with AA artillery illustrates the difficulties of keeping up with the accelerat-



In war, small planes using merchant ships or even submarines as tenders might make hit-and-run bombing raids against our coastal cities

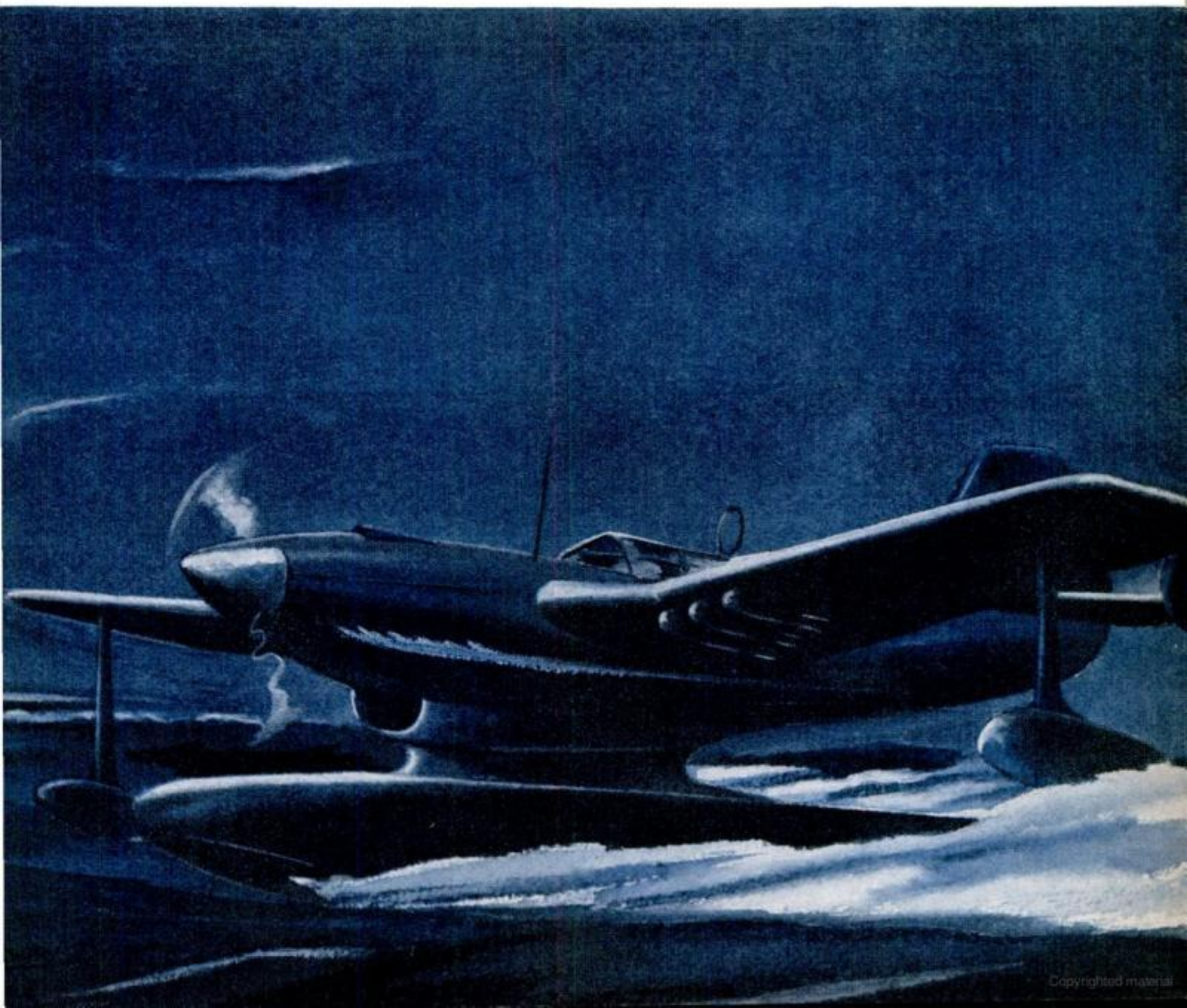
ed development of the art of war. Only a few years ago, with slow bombers flying at relatively low altitudes, the three-inch AA gun was effective. But in those few years the speed and ceiling of bombers more than doubled. The problem now is to bring down a 200-m.p.h. plane at 25,000 to 30,000 feet. The three-inch gun begins to peter out at 18,000 feet and above 20,000 it is practically useless. The loaded bombers can fly 8,000 feet higher and still hit area targets. They are too high then for point targets—but in wartime nobody bothers much with little distinctions like that. A point target becomes an area target if you don't manage to hit it.

Consequently the five-inch AA cannon is now the Army's requirement. But that does not mean that the smaller guns are obsolete, either here or in Europe. The five-inch gun requires an emplacement. Thus it is ideally suited for the defense of the Panama Canal, for example, but for general coast defense the United States needs mobile AA artillery, which can be concentrated at threatened points on either coast, on the same theory

as defense by plane in the event that the Fleet is unavailable by reason of obstruction of the Canal or other contingency. That means 3.5-inch guns, like the German 88 mm., and 20 mm. (less than one-inch) guns mounted on buildings and at emplacements to protect the big guns.

AA defense by artillery and pursuit aviation is necessary, for the same reason that our prize fighter who prefers to box at arm's length must still be prepared to fight at close quarters some of the time. But for the United States it is secondary defense at best. The primary defense remains the Navy and defensive-offensive bomber operations by the Army and Navy in conjunction with the Fleet.

Many people imagine that with the increasing mechanization of war, men are no longer important. The Army and Navy know that the exact opposite is the truth. As General Fox Conner puts it, "the engineer of a modern express train must be more highly trained and more intelligent than a one-horse plow boy." The training of military airmen is as vital as the pro-



curement of sufficient planes and guns.

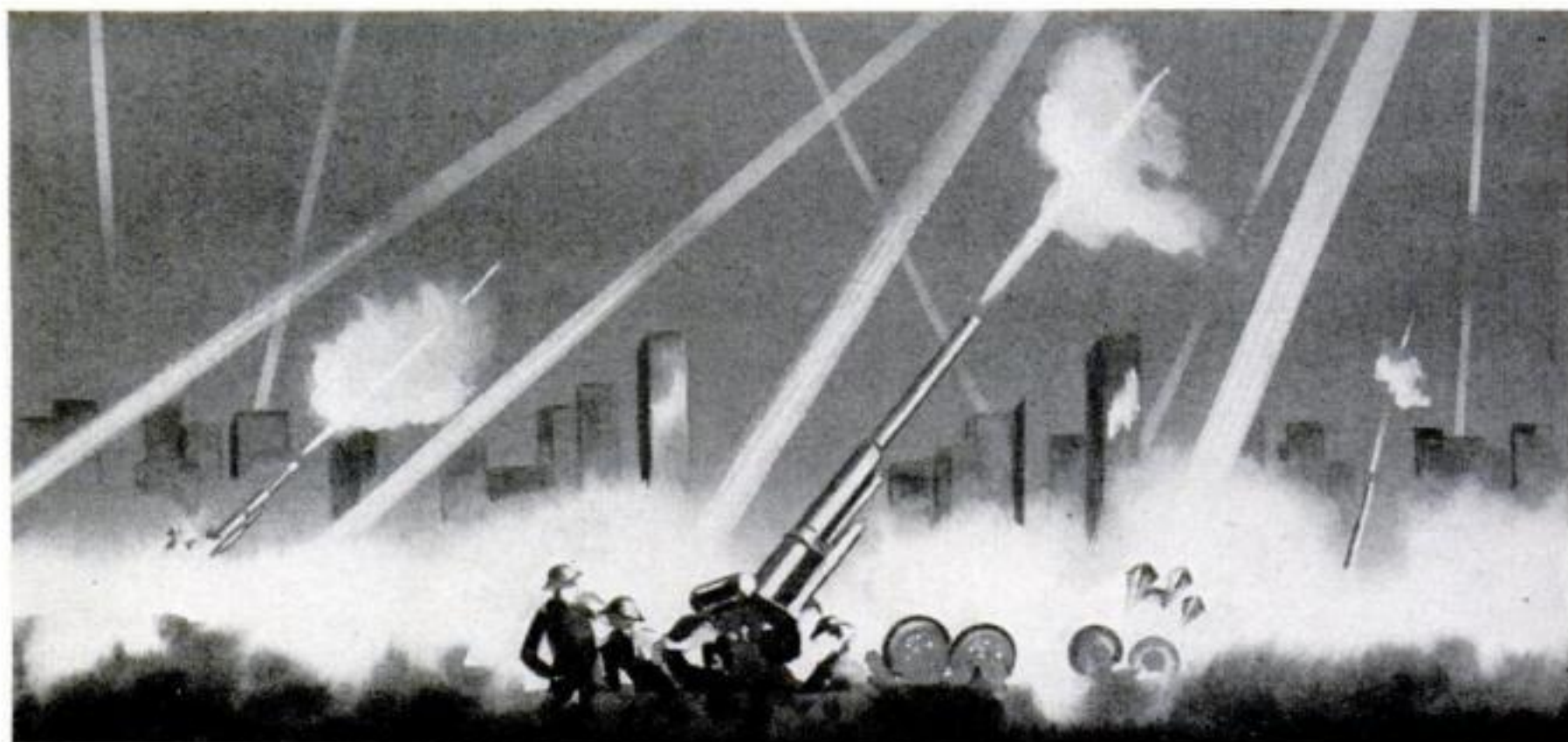
It is a much harder job now than in the World War. At that time a man could be trained on a Jennie and when he was sent up in a combat plane there was no vast disparity. Nowadays the difference in handling between a primary trainer and a fast pursuit ship or a big bomber is as great as the difference between Sunday driving and automobile racing. Pilots must be trained in steps, and their training does not end even after they have been flying with the Army and Navy for years. And this is equally true of mechanics, radio operators, armorers, parachute riggers, and all the other classifications.

American pilots are being trained in considerable numbers under a comprehensive program which has two principal objectives. The first is to impound a large reservoir of young men who can fly well enough to meet the requirements for private-pilot-grade licenses. This part of the program is under the direction of the Civil Aeronautics Administration and training is given at colleges in the form of Civilian Pilot Training courses. By June 30, 1941, 50,000 students will have received instruction in the rudiments of flight and a certain percentage of these will constitute the raw material of the expanded air forces. The elementary, part-time training of the C. A. A. must not be confused with the full-time flying courses of the Army and Navy, given at Kelly Field and Pensacola, respectively, with other training centers being built to multiply the pilot-producing capacity of the services. The objective of the latter is to turn out combat flyers equipped to continue their training in army and navy operations.

The United States holds a tremendous advantage in turning out pilots in that we have an unlimited gasoline supply. Under

our system a cadet in the military flying course earns his commission as a second lieutenant after nine months of training, with 300 hours in ground classes and 215 hours in the air. After that he continues to get instruction and experience with the tactical unit to which he is assigned. No other country can afford such expensive preparation for its air service. To give 10,000 men 500 hours apiece in the air requires 400,000,000 gallons of gasoline to begin with. European countries haven't got gas on that scale. Consequently they lose flyers in combat who might have survived if they had received more and better training, and they lose them in training for the same reason.

We had the same experience in 1917; many of us can remember the motto at the Kelly Field of that day: "Fly or Die!" That meant one a day for the undertaker. The policy and its results are different now. In the C. A. A. portion of the pilot-training program the fatalities are practically negligible—around 110,000 man-hours in the air to one fatality, and the majority of the dozen or so fatal crack-ups which have occurred have been the result of extreme recklessness. In the service courses the ratio of crack-ups is likewise low, largely because utmost care is taken to weed out accident-prone candidates and trainees. Five out of six are rejected for physical or nervous defects, and after that almost half the survivors are washed out during the course, the great majority in the elementary grade. The ratio of those who qualify for actual military service is therefore about 1 in 12. One can depend on it that most of that 8.5 percent of picked men will be pretty good material for the stupendous job of organizing squadrons, groups, wings, and air divisions on the scale contemplated.



I have already expressed the opinion that this country is safe from invasion if we do not throw away our geographical and other blessings. Some mistakes can be made—but, as in any other job, not too many. To that end certain criticisms of our air-defense program are in order.

1. In the first place, it needs to be said that the whole 50,000-planes idea is a typically American substitution of bigness and ballyhoo for incisive technical thinking. We talk of 50,000 planes without specifying what types, and what each type is to be used for, or exactly how such a Gargantuan fleet of aircraft will fit into the integrated defense scheme. A digit with a lot of zeros after it is no guarantee of national security. We may merely be manufacturing obsolescence. Fifty thousand planes can be as wrong as fifty million Frenchmen.

2. The public should be taken into the Government's confidence to a greater extent in regard to military planning, and particularly in the air phase. Not legitimate military secrets, of course: the Army cannot be expected to advertise that it is setting up a five-inch AA battery at Hempstead and a pom-pom outfit on the R.C.A. Building, nor need the Navy tell us the precise measures it is taking to protect the Panama Canal. But neither should the broad outlines of planning be left entirely to the conjectures of columnists and commentators. A great deal of good can come out of the participation of the average man in such matters, as it has in the past. In the January-February 1940 issue of the "Coast Artillery Journal" Major Thomas R. Phillips wrote, "The air force that all admit we need was forced on the Army by popular demand and congressional action, however little we may like to admit it." That is a patriotic and democratic attitude, and it should be the rule rather than the exception among our military men.

3. We are not devoting enough time and money to aeronautical research. Our military planes are very good, but tomorrow's wars are not going to be fought with today's planes. The Germans planned their present air force for support of a motorized army and to bomb near-by objectives. The



Student training under the C.A.A. provides a reservoir of pilot material

planes are not outstanding in design or performance, but they were designed for exactly what they are doing and produced with exceptional technical efficiency. If the Germans are ever in a position to get after us they will need different planes—and all the indications are that they will have them. Whether we shall be as well off is doubtful. Germany has seven great centers for aeronautical research, each equivalent to our excellent but overloaded National Advisory Committee for Aeronautics laboratory, each specializing in one portion of the field and coördinating its investigations with the others. Major Eliot is right when he says, "To a modern air force, research is the very breath of life." The last thing we can afford to do is to put almost all our energy into profitable production and to give only incidental attention to the aircraft of the future and the knowledge which will create them. The planes that will win the air wars of tomorrow have to be designed today.

4. The more discussion of air defense the better, but discussion is one thing and hysteria another. Some of our people are overwrought on the subject, to say the least. Such a state of mind, when it becomes widespread, is a definite military danger. At the beginning of the Spanish-American War our eastern seaboard cities were in such mortal fear of the pitiable Spanish fleet that for some time our battleships had to be kept inshore to "protect" the population. Certain newspapers were responsible for this exhibition, which one would like to forget if it did not teach a lesson for the present day. A few months ago one of our leading magazines, which boasts that it has 20,000,000 readers, printed a lurid sketch

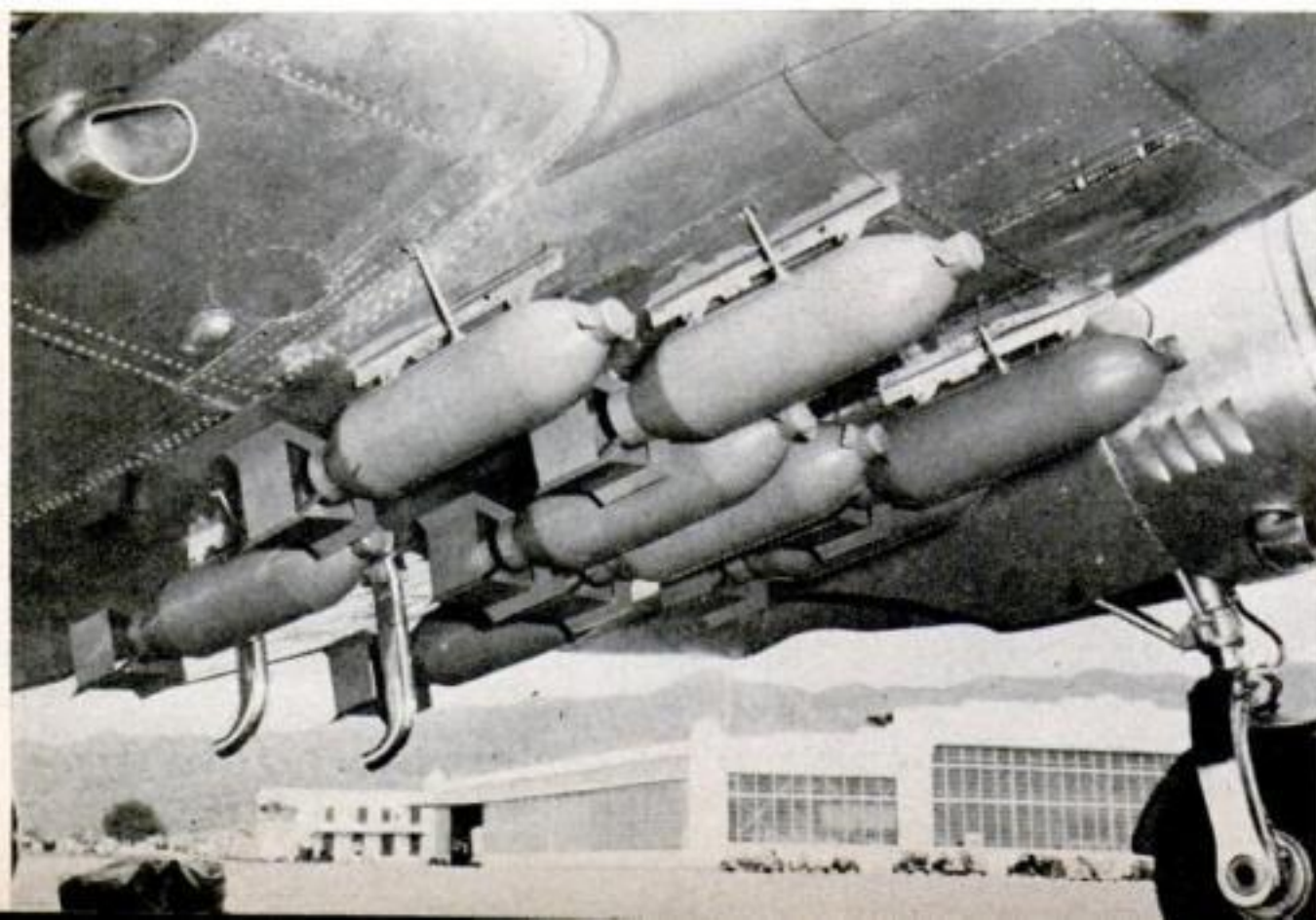
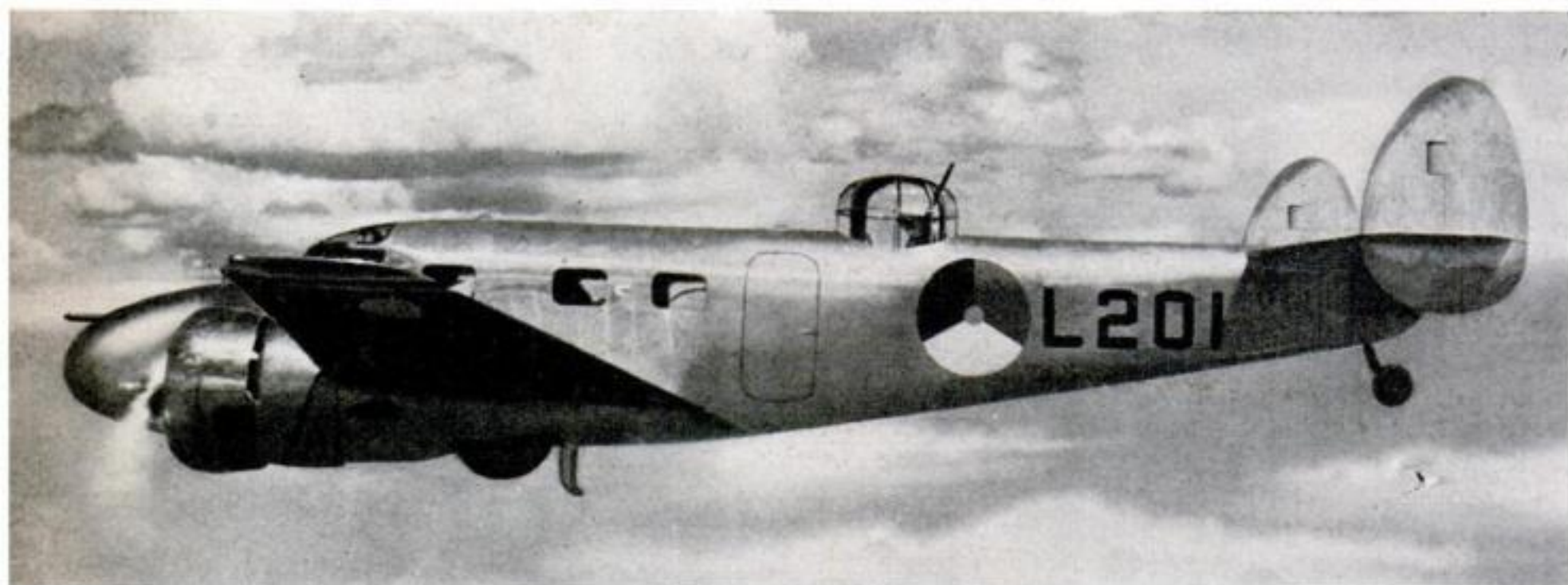
of New Yorkers dying of thirst in the streets, the Croton Dam having been bombed from the air by the Fascists, who, it seems, got there by easy stages from Pará, Brazil. This sort of thing plays directly into the hands of the totalitarians, to whom terror is a favorite weapon, and especially terror from the skies. Their own highly efficient machinery for demoralizing their enemies couldn't do a better job.

5. It is questionable whether the army requirement of two years of college for flying cadets and the admittance of only five percent of non-collegians represents a sound policy. The British abandoned this basis of selection some time ago. There may be some sense in the rule as far as navigators and bombardiers are concerned (although most college graduates have no aptitude whatever for mathematics and graphical analysis) but it seems to have no bearing on the competence of pursuit pilots. Certainly old-fashioned army snobbery should not enter into such a question at all. To "check on the candidates' social background," which the officer in charge of recruiting in the Second Corps Area re-

cently specified as one step in the determination of eligibility for flying cadets, is to bar from training many young men with excellent qualifications for one of the hardest jobs in the world. What has "social background" got to do with the building of a modern, democratic, and efficient air force?

THE title of this article means exactly what it says, and no more. All of the foregoing applies to defense, and to defense only. If we allow ourselves to be led into grandiose military adventures abroad, or if we break down under the stress of political and social difficulties at home, we may undergo agonies comparable to those which the victims of Fascism are suffering in Europe, Asia, and Africa today. Against that all the planes in the world are no insurance.

But barring disasters of our own creation, the conclusion of this survey is that our air defense is as sound as any human institution can well be, and that we have every incentive and opportunity to keep it so. And that is as far as any forecast can go.



One of 16 Lockheed transport planes converted for scout-bomber duty in the Dutch East Indies. A similar plan has been proposed for emergency use in America

Each plane carries 100-pound demolition bombs slung under its fuselage, and mounts machine guns in the nose and in a turret

New Movie Camera Saves Cameraman 100 Minutes A Day

WEIGHING only one fifth as much as a conventional movie camera, a new-type camera has been perfected by technicians of Twentieth Century-Fox Studios in Hollywood. It tips the scales at 120 pounds, is virtually silent, and will permit moving effects by changing focus through an external lever while a scene is in progress.

With the older-style "blimps," the camera crew must move through seven steps before the shooting can start. Only one movement, turning of a device on the motor which opens the shutter aperture and fogs a starting mark on the film for synchronization of sound with the picture, is necessary on the new camera. This operation requires only a fraction of a second, a step required 75 times a day on any picture, saving 100 minutes every shooting day, or 40 hours daily when all sound stages are in operation.

When preparing to film a scene, the cameraman swings the film magazine out of the way, and views the stage through a monitoring finder which parallels the lens. Brakes are applied automatically to the magazines when the camera is stopped, thus preventing curling and scratching of the film. Four lenses of different focal lengths may be shifted at will in a circle.

Where formerly an assistant held a slate bearing the director's name, number of the scene and take, before a scene was started, now a tiny slate smaller than your hand is swung briefly on an arm right before the lens. The slate arm carries its own optical and lighting system, and is operated by the assistant cameraman while his chief is coming up to speed with the sound system.

To keep each frame on the film sharply in definition, each lens has a diaphragm calibration calculated by photo-electric readings which insures consistent exposures regardless of the lens used. The lenses are coated by a secret chemical formula developed by Bausch and Lomb Optical Company engineers which increases the light transmission, eliminates fog and halation, and improves contrast.

Two finders, one direct and the other indirect, give the cameraman a clear view of all parts of the fields. Also, the finder's focus changes with the lens focus, thus assuring sharp, clear views of the action throughout.



With the new camera, focus can be changed in shooting by moving a lever



Instead of the large, clumsy "slate" to identify each shot, a small, self-lighted one is employed



Two of the inventors of the camera: Grover Laube operates the focusing lever while Robert G. Stevens views the scene

Ready to Roll

Transportation Organizes to Meet Defense Needs

TROOPS and tanks, planes and bombs, guns and ammunition are all mighty words in the language of the defense program of the United States. But mightier than all of them is the key word: "Transportation."

That is why President Roosevelt, in calling upon leading industrialists to help coordinate the nation's greatest peacetime military effort, included a veteran railroad man with a reputation for getting things done.

Men, materials, and machines, the three essential ingredients of modern military power, are worthless unless the nation possessing them has a transportation system capable of getting them where they are needed at the time they are needed.

It is part of the task of the National Defense Advisory Commission to see that America gets the most out of its railroads, its highways, its air lines, its waterways, and its pipe lines during the industrial mobilization, and to plan just how all those systems should function if they had to be used during a conflict.

We have something to work with—no

doubt about that. This country has more trains running over more miles of railroad than any other nation. It has more miles of commercial airways, more automobiles, and more motor trucks than any other world power. It has more miles of hard-surface roads, of inland waterways, and of pipe lines for petroleum products.

But we have also the knowledge that a transportation system just as great for its time bogged down pretty badly during the World War, and it is up to the Commission's representative of transportation to see that that doesn't happen again.

His job on the N. D. A. C. is divided into two parts—the first the industrial mobilization end and the other the plan for war emergency.

On the first, the program should anticipate nation-wide and local transportation needs as far in advance as possible, and then should get the various carriers to transport defense materials and men without delaying the normal commercial business of the country.

In war, of course, civilian needs would be subordinated to military needs. But bar-



The Army tries out a car-delivery trailer as a means of moving 75's across country in a hurry

ring actual invasion, it is probable that even war would not disrupt ordinary shipments—provided plans had been made wisely.

With wise planning as its goal, the Commission has added to its staff representatives of each type of transportation—men who may fight each other to the last ditch for business but who are working together wholeheartedly in coordinating transportation for patriotic purposes.

They've already guarded against one of the worst tangles that marred transportation during the World War. Failure of freight receivers to unload cars promptly and the Government's wholesale and sometimes senseless use of priorities were the chief causes of the bogging down of the railroads in the war winter of 1917-18. Because of lack of coordination between rail and overseas transportation loaded cars piled up in the terminals of eastern seaports. The tangle was made worse by government contractors ordering large quantities of materials which they wouldn't need for weeks and which they had no place to store when they received it. At one time there were 5,000 carloads of piling for the Hog Island shipyard clogging the Philadelphia yards, with the fanciful trimming of a number of cars loaded with anchors for ships whose keels hadn't been laid. Eventually there were over 200,000 loaded freight cars—nine out of ten of them plastered with red priority tags—serving as ware-

houses on wheels in railroad yards along the eastern seaboard, and causing a shortage of 150,000 cars in other sections of the country and a traffic jam which extended west of Pittsburgh. The snarl wasn't cleared until all freight into the congested area was embargoed while the misused cars were being unloaded and the yards cleaned out.

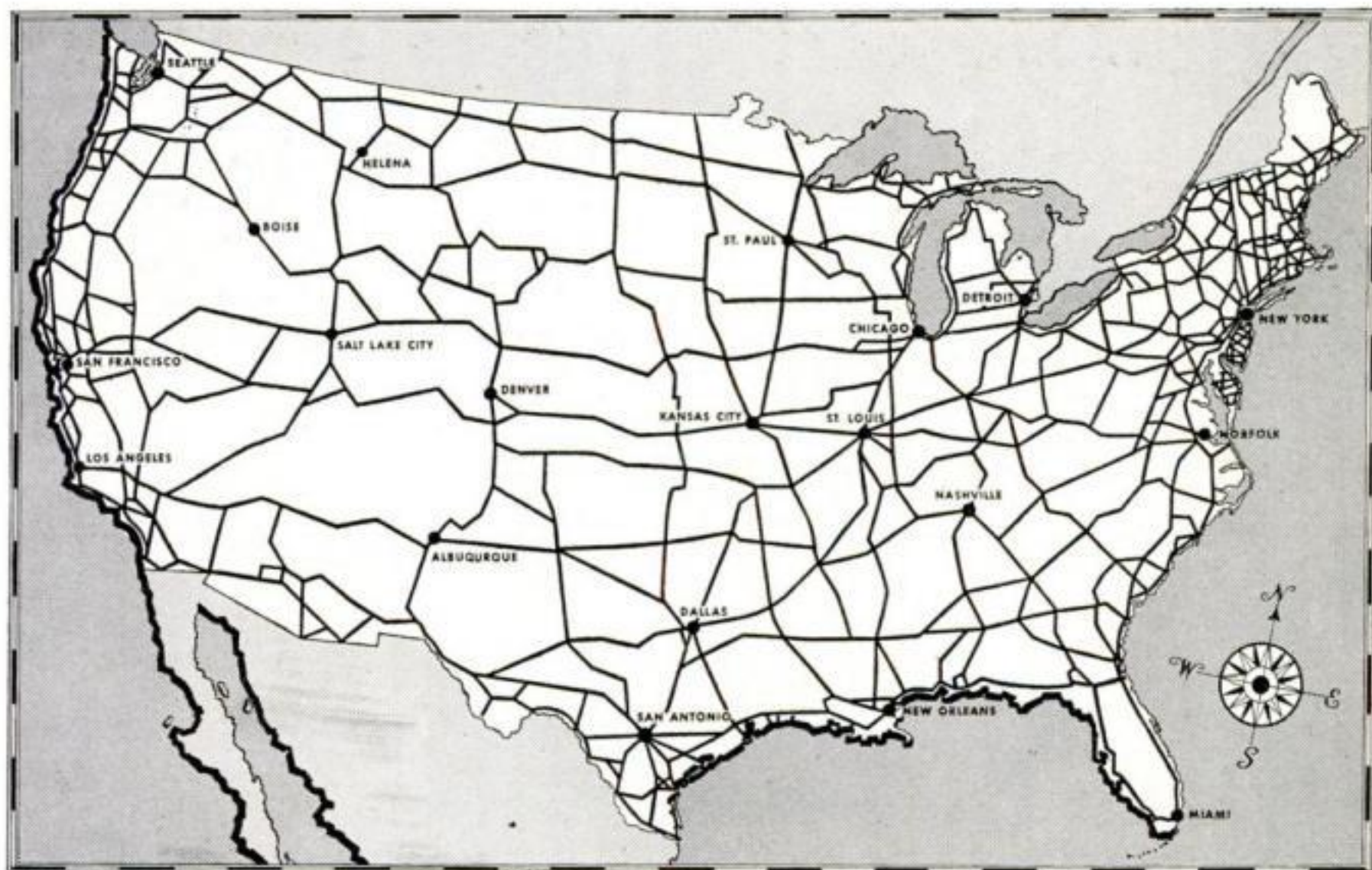
Now, because of that sad memory, the Army and Navy Munitions Boards specify that railroad cars must not be loaded with defense materials unless it is known that they can be unloaded promptly at their destination.

The railroads are able to exercise the same power to prevent tie-ups through the operation of a well-tested embargo system. Congestion in seaboard areas is averted by their port control organization. It is notable that last year the North Atlantic ports handled more than three quarters as much export business as they did in 1918, and handled it without delay. It is notable, too, that there hasn't been a car shortage since 1922.

Another step to help make certain that no such shortage ever develops in any defense emergency is a coordinated warehousing program to eliminate the World War practice of using cars for storage. At key points, ample space will be provided for storing materials that cannot be absorbed by the defense industries as soon as delivered.

The N. D. A. C. estimates that the na-

A military asset: our 75,000 miles of strategic highways



tional defense program, including additional steel production, plant expansion, and camp construction, plus the maintenance of a large army and a possible increase in commercial freight caused by better business, will result in a maximum traffic increase of less than 50,000 carloads a week.

That would be about eight percent of the average weekly car loadings in 1939. In that year, in one five-month period, car loadings increased by 55 percent. Yet even in the peak month of October, with an average of 843,736 cars a week handled, the railroads had an average daily surplus of 66,000 serviceable cars. That surplus would be enough to take care of the defense increase. But already 25,000 new cars have been bought—and so that end of the job will work out all right.

As important an asset as the railroads is the nation's network of a million miles of hard-surface roads.

The War Department considers 75,000 miles of them to be of strategic importance.

But—14,000 of these are deficient in the surface strength necessary to support heavy loads; more than 4,000 miles should be widened, and for military purposes most of the strategic roads need shoulders every two miles at which truck convoys can park.

Bringing these roads up to the standard desired by the Army will be an expensive project, but it is a necessary one. Just as necessary are the building of 3,000 miles of access roads for camps, military posts, and new industrial plants, and the construction of city connections for strategically important highways.

Highways are already doing their full share in carrying the industrial-mobilization traffic, and as the defense load grows, so will their importance increase. The N. D. A. C. is aware that the value of the roads would be heightened by uniformity of regulations for trucks in the various states. That's another problem that may be solved.

Inland waterways play a part in the de-

defense program because of the heavy cargoes of ore, coal, grain, and oil that can be sent to key points in their barges. We now have 17,000 miles of improved inland waterways which are more than four feet deep, and the barge lines which use them are increasing in importance as freight carriers. Most of this traffic is on the Mississippi, Missouri, Ohio, and Illinois rivers and on New York's Hudson Barge Canal, but there also are barge lines on the Sacramento, Columbia, Snake and other Pacific Coast rivers, and on a few eastern and southern waterways. But in spite of the growth of this business the Great Lakes whaleback steamers, which transport heavy cargoes of ore, coal, grain and oil from May to mid-December remain by far our most important inland water-borne carriers.

Pipe lines move an equivalent of 3,330,000 carloads of petroleum and its products each year. Since gasoline and



Ocean and inland-waterways shipping is being geared for emergencies



New bridge and road construction will supplement our network of 1,000,000 miles of highways

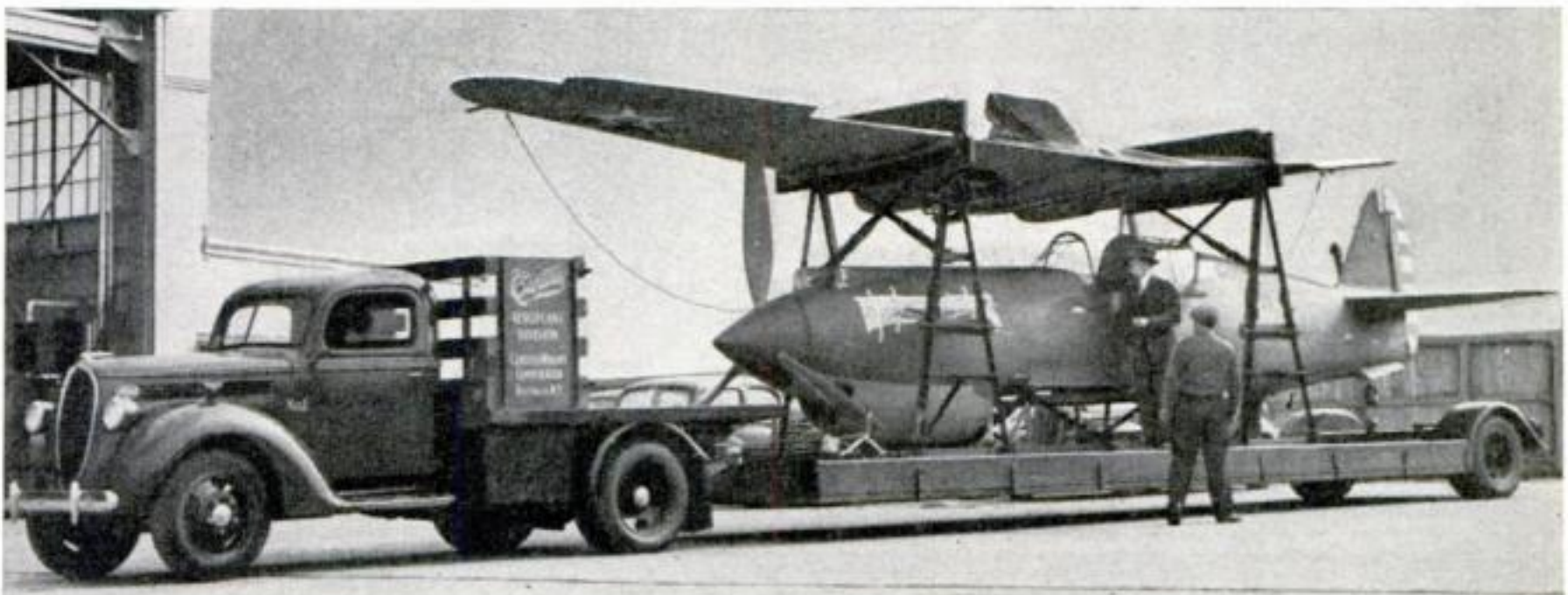
oil are the lifeblood of modern mechanized warfare, this underground transportation network would play a vital part in any conflict and, even in time of peace, contributes greatly to our defense preparations by releasing railroad, truck, and shipping capacity for other purposes.

Another great asset is our highly developed system of air lines. In addition to mail and passenger traffic, express service is

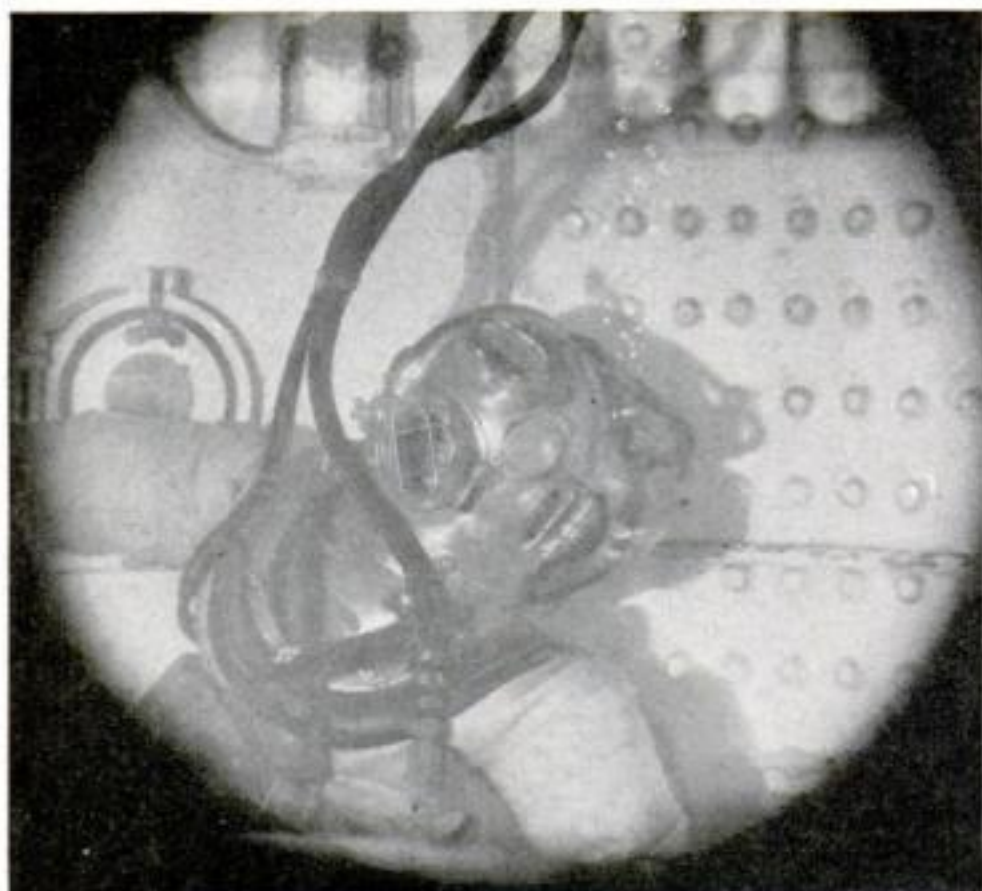
increasing so greatly that there is talk of establishing an out-and-out cargo-carrying line.

They're all part of the defense program—just as much a part as are machine guns and artillery.

And because that's true, the millions of workers on the transportation lines have become civilian soldiers in the mobilization of America's resources.



Trailers like this may speed the transportation of new planes from one part of the country to another



Pressure-tank tests in icy water proved that divers in the electrically heated suit could stay under water twice as long

Navy Divers Keep Warm in Glass-Lined Heated Suits

NAVY deep-sea divers are now kept warm by electrically heated, glass-fiber-insulated diving suits. Telephone connections with an operator at the surface who controls the heating unit enable divers to work in any temperature they wish. Tests show that divers using the new suit can work twice as long as they formerly could in the low temperatures at great depths.



Troop-Landing Boat Climbs Beach



With 35 soldiers aboard, the boat will draw less than six inches of water

A BEACH-CLIMBING speedboat for landing troops from transports has been built for the Navy by the Chris-Craft Corporation. With an overall length of 30 feet, it can make 35 miles an hour empty, or 12 with a full load of 35 soldiers. Two metal-faced skegs on the bottom act as runners and enable the boat to work its way into water less than six inches deep. Metal plates lowered in front of the twin propellers impart a lifting motion to the hull when it is being backed out of shallow water to return to a ship after unloading or embarking troops.



PRINTER, 2ND CL



CHIEF YEOMAN



PAINTER, PATTERNMAKER,
CARPENTER'S MATE, 1st CL.



FIRE CONTROLMAN, 3rd CL.



Sleeve Marks Tell Who's Who Among Navy Enlisted Men

RATING badges and specialty marks denote who's who among the Navy's enlisted personnel. Petty officers wear an eagle above the specialty mark and one, two, or three chevrons below, depending on whether the officer is third, second, or first class. Chief petty officers have an arch above the three chevrons. Men below the rating of petty officer wear a stripe of braid on the right shoulder; white or blue for seamen, red for men of the engineer force. Service stripes, one for each four years, are worn on the left sleeve. Some specialty marks are worn without the rating badges.



STOREKEEPER



BUGLEMASTER-BUGLER



SHIPS COOK-BAKER



SEAMAN GUNNER



MUSICIAN-BANDMASTER



EXPERT RIFLEMAN



PARACHUTE MAN



SHARPSHOOTER



NAVY 'E' EFFICIENCY
IN ENGINEERING



SUBMARINE INSIGNIA



GUN CAPTAIN



AEROGRAPHER



ORDNANCEMAN-AVIATION



OFFICERS' STEWARD, 3rd CL.



SAILMAKERS MATE



EX-APPRENTICE



GUNPOINTER, 1st CL.



PHARMACIST'S MATE



SIGNALMAN



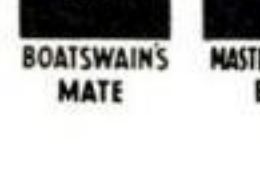
COMMISSARY
STEWARD



ELECTRICIAN'S MATE



BOATSWAIN'S
MATE



MASTER HORIZONTAL
BOMBER



CARPENTER'S MATE-AVIATION



RIGID AIRSHIP



METALSMITH-AVIATION



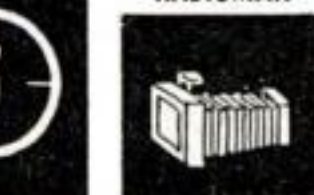
MACHINIST'S MATE-AVIATION



GENERAL UTILITY-AVIATION



RADIOMAN



PHOTOGRAPHER



GUNNER'S MATE



TORPEDOMAN



QUARTERMASTER



TURRET CAPTAIN



MACHINIST'S MATE



SHIPFITTER-METALSMITH



MASTER DIVER



BOMBER MECHANIC



NAVY 'E' EFFICIENCY
IN GUNNERY

Little Boats with Mighty Stings

By DAVID M. STEARNS

"DO IT YESTERDAY" is the motto of the U.S. Navy's newest unit, Motor Torpedo Boat Squadron 1. The boys of the "sandwich navy" picked that because they travel so fast that if they didn't do it yesterday they may not get a chance to do it at all.

"M.T.B. Ron 1," as it is known officially, is composed of seventy-foot, 60-mile-an-hour wooden speedboats, each armed with four torpedoes in deck tubes and two twin mounts of heavy-caliber machine guns. The Navy ordered 23 of these mosquito boats a year ago for experiments and gave the job of organizing them and studying their potentialities to Lieut. Earl S. Caldwell, Annapolis, '26. Now they are being turned out at the rate of one a week by a specially

constructed plant of the Electric Boat Company at Bayonne, N. J., and more have been ordered.

Boats of the mosquito fleet, designated by the letters PT (Patrol Torpedo) and a number, are modeled after the latest of the British M.T.B.'s designed by Hubert Scott-Paine, the "Gar Wood of England." This design was chosen by the Navy after comparative tests with American-designed and built boats of the same type.

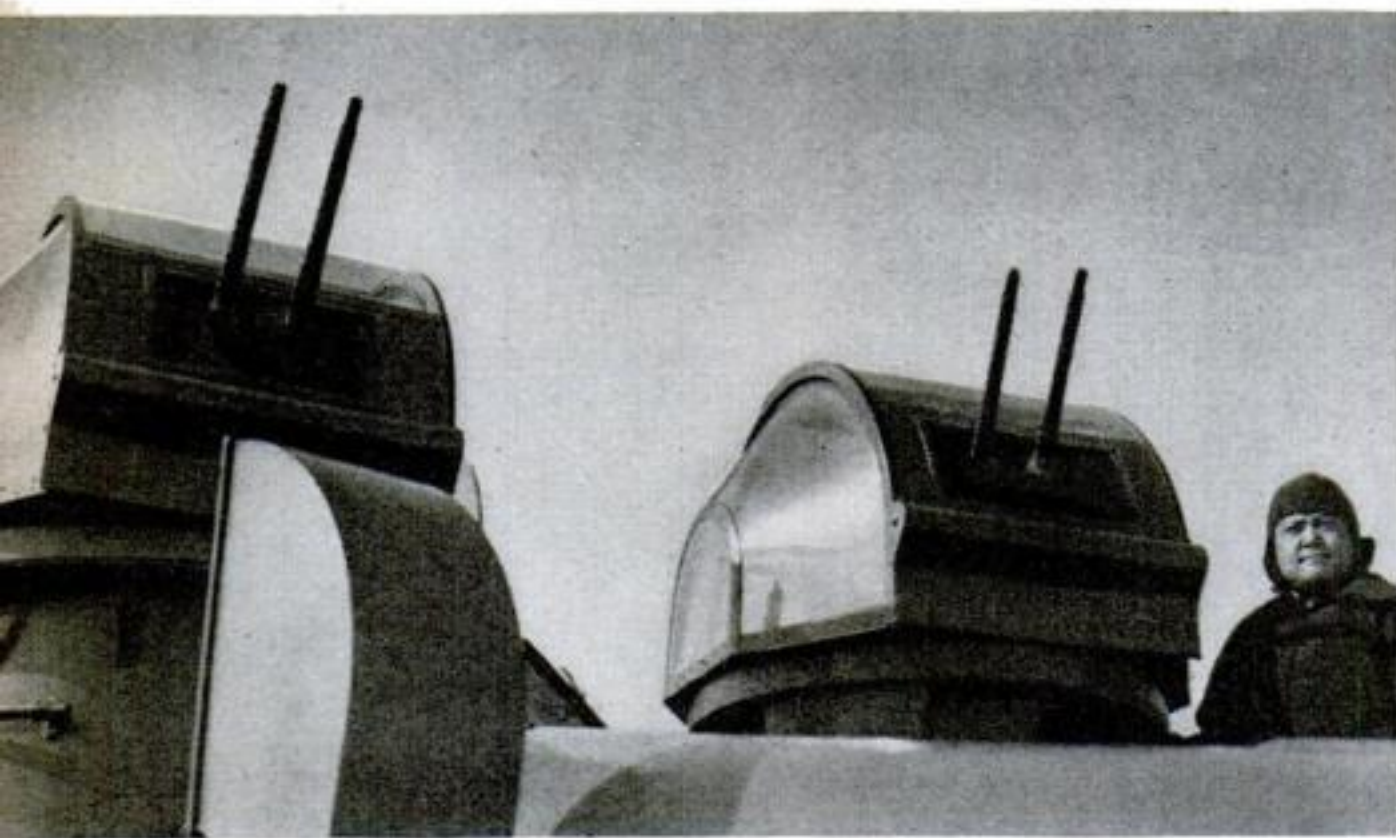
Each is powered with three supercharged Packard 1,350-horsepower, 12-cylinder engines designed for marine work. An inkling of the boats' power is given by their "idling" speed. With all engines in gear and turning over at their lowest speed, the boats travel at better than ten knots, a respectable top speed for any ordinary motor cruiser.

The power plants, with auxiliary equipment, fill the after end of the hull. Amid-

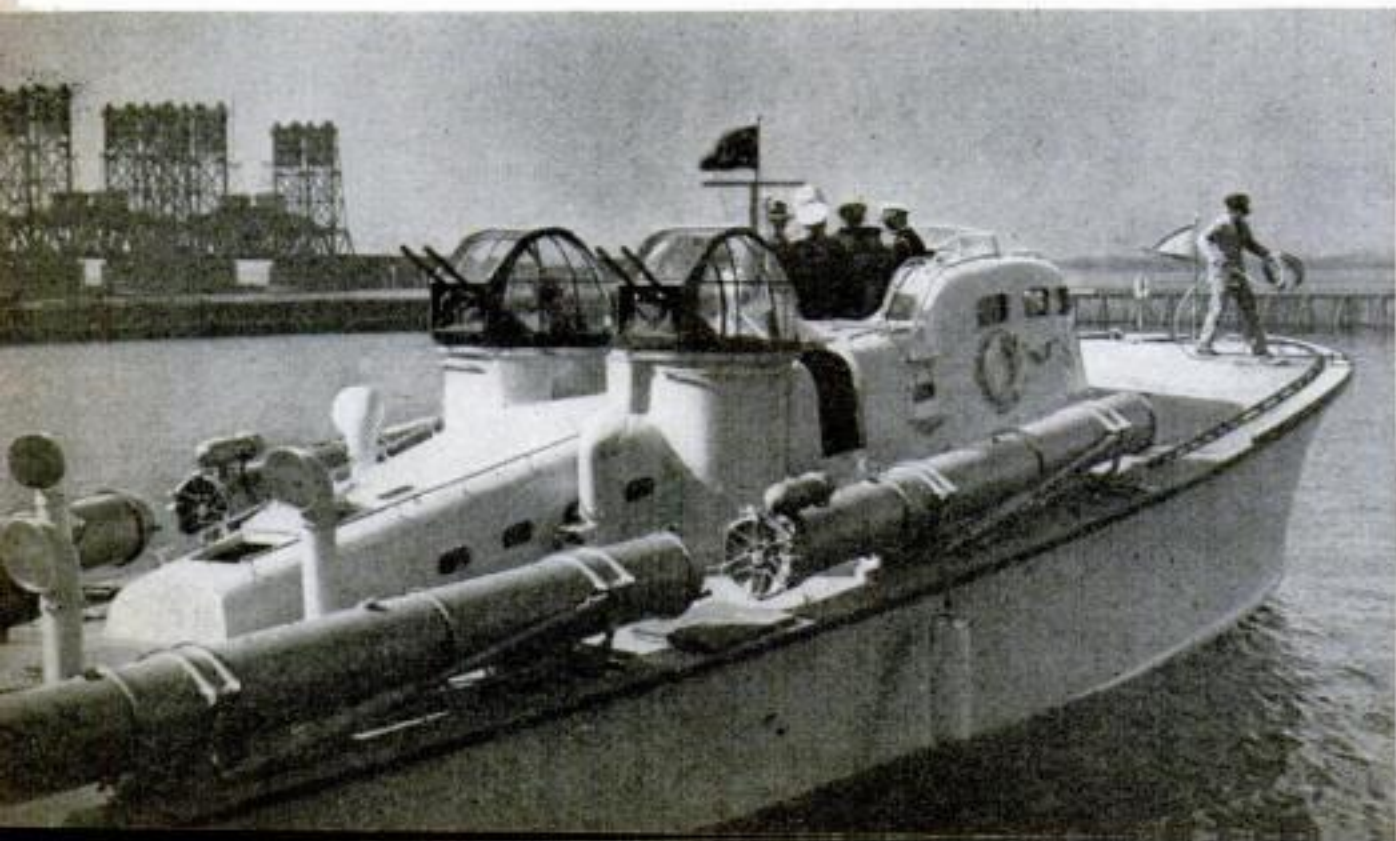
ships is a small cabin for navigation and radio work, with tanks beneath and beside it, officers' cabins crammed between the cabin sides and the hull, and machine-gun turrets in its after end. Forward of the cabin is the bridge, with an outside control station just aft and above it, from which the boat would be commanded in action. Under the rounded foredeck are a miniature galley and quarters for the eight crew members.

Each boat carries one or two officers, usually ensigns or lieutenants. Because of the cramped quarters and hard work, crew members are chosen for their stamina and resourcefulness. Operating these supercharged surfboards at sea involves so much uncertain motion that only sandwiches, and beverages in heavy cups, can be served when under way. Hence the term

... while torpedoes in deck tubes are reserved for swift, stunning raids against the capital ships



Against enemy planes and surface craft at close range, the boats of the "sandwich navy" are armed with heavy-caliber machine guns . . .

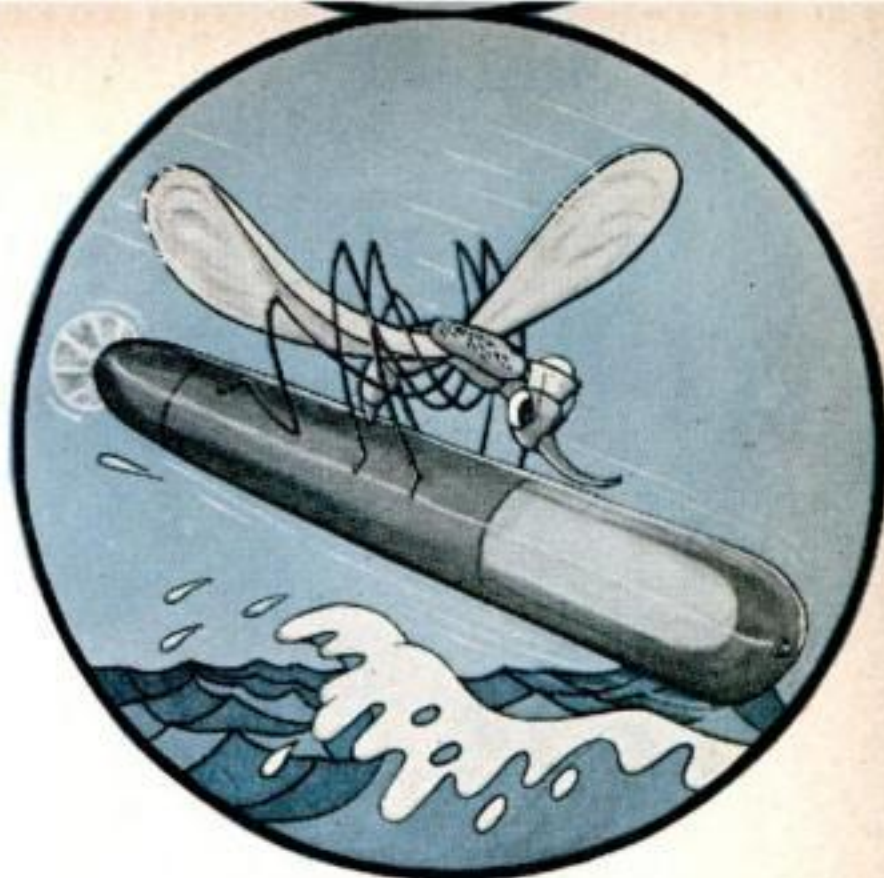


POPULAR SCIENCE

"sandwich navy," coined by the enlisted men.

Officers and men alike of the mosquito fleet are confident that the Navy soon will have hundreds of these speedy stingers. They point out that four of them, converging on an enemy ship intent on raiding the coastline, could lay down a barrage of sixteen torpedoes, and it would be a major miracle if at least one of them didn't find the target.

Equipped as they are with smoke-screening apparatus (some of them also will carry depth charges for combating submarine activity) they could be used as a scouting force or screen for heavier ships, or as an effective coastal patrol. As one officer put it recently, they are "weapons of opportunity," which might prove invaluable under certain conditions, and the Navy plans to have enough of them to take advantage of whatever "opportunities" might occur.



Walt Disney's mad mosquito is the insignia



Mile-a-minute speed and maneuverability make the mosquito boats hard to hit. Each vessel is designated by the letters PT and a number



Life on these supercharged surfboards is no bed of roses. A crew consists of eight men, chosen for stamina, and one or two officers





Steps appear as this pursuit ship's door slides down on tracks

Door of Pursuit Ship Becomes Stepladder for Climbing Aboard

ALWAYS searching for new ways to save weight and space, engineers developed a combination door and stepladder for the U.S. Army's twin-engined Airacuda pursuit plane. In the closed position, the door fits flush in the side of the fuselage just forward of the wing. When it is opened, the door slides downward on tracks until the lower end hangs just above the ground. Pressure on a lever then folds back three small plates, leaving holes which form the "rungs" of the ladder. When the door is returned to the closed position, the plates automatically fall back into place so that there will be no break in the streamlined surface of the fuselage, to create wind resistance in flight.

New Rock-Hard Cement Is Tested for Bomb Shelters

CEMENT that is almost as hard as the rock from which it is originally made has been developed at a mill near Azusa, Calif., where recent tests were made to demonstrate its value in structures such as gun emplacements and bomb shelters. It is a by-product of an experimental method of extracting gold from low-grade ores, which involves shooting rock particles at each other with tremendous velocity in opposing jets of water. When the particles have reduced themselves to a minute size, they are further pulverized by mill-stones while still in a water solution, and dried. Dr. Christian Paul, specialist in colloidal chemistry, reports that when the resulting rock dust is again mixed with water and dried it forms a substance with a compression strength several times that of concrete.



A powerful bullet just penetrates 1/2" of the new cement



How the rock-hard sheets can be shaped to protect an infantryman

MOUNTS

FROM HORSES TO BANTAMS,
THE ARMY TRIES 'EM ALL



While one branch of the Army takes on 20,000 more "hayburners," . . .



. . . another branch puts a quarter-ton scout car through its paces

MOTORIZED mounts for the Army, though they are being turned out in tremendous quantities, apparently will not completely replace horses for a long time to come. While one branch of the service was experimenting recently with a quarter-ton Bantam car, another was busy adding 20,000 horses to the 17,000 "hayburners" already in use.

Acting on the theory that horses can still go places that trucks and tanks can't go, the Army reorganized its two cavalry divisions and added to its horse-drawn artillery forces. In many units trucks have been provided to transport Dobbin to points near where he might be useful.

While the horses were joining up, the Bantam was being given a work-out at the Camp Holabird Quartermaster Depot. It is designed for scouting, and carries three men armed with rifles or a .30-caliber machine gun mounted on a tripod.



A mule takes the physical examination



How the tiny scout car stacks up against other army vehicles



Two-Day Turnaround

SPLIT-SECOND SERVICING KEEPS THE CLIPPERS FLYING



Replacing hull paint with lanolin saved the weight of a refugee child

WITH 3,500 miles of ocean behind her, a transatlantic Clipper plane skims to an 80-mile-an-hour landing at the Pan-American Airways terminal in New York City. Forty-eight hours later, it soars away again on the eastward run to Portugal. Between those two events, 150 picked men, working with the efficiency of speedway mechanics, have overhauled the great flying boat in a revolutionary "two-day turnaround" which enables three machines to maintain a three-flights-a-week schedule to Europe where, six months ago, four ships were needed to make two flights a week.

As the Clipper lands, a boat goes to meet her with mooring lines...

... with which she is made fast to the dock to discharge passengers and mail

Drums full of water are hung from the wings to steady the big craft





In the hangar, three-story, 15-ton working platforms allow mechanics to swarm all over a Clipper

As these sky liners cost three quarters of a million dollars apiece, the new overhaul procedure saves \$2,250,000 in capital invested.

Specially designed equipment, including a square-ended motor boat unlike any other craft afloat, a 20-ton beaching cradle, and a \$10,000, 15-ton working platform as high as a three-story building, save seconds in the mechanics' race against time.

Almost as soon as the big ship docks, white-clad inspectors, with flash lights and testing tools, begin their work. They check over everything on board, from the 4½ miles of wire and cable to the 489 kinds of emergency equipment carried; from the 1,000 feet of weather stripping to the four 1,500-horsepower Cyclone engines with their total of 25,000 different parts; from the 576,000 rivets to the single fly swatter that rides aboard the giant boat on every flight.

At the same time, in the office of Division Engineer Edward W. McVitty, the two flight engineers, who have jotted down some 1,300 instrument readings during the crossing, are making rapid-fire suggestions to crew foremen. Work orders begin pouring from the conference room. As many as 1,500 different jobs are performed during the two days the ship is in the closely guarded hangar at the far side of LaGuardia



Replacing one of the 576,000 rivets, this worker talks by phone to his helper inside the big ship

Field. Each job is given in a written assignment to a definite workman. When it is finished, three different signatures—those of the worker, the foreman, and the inspector—are required on the work sheet. This triple check on the job eliminates the possibility of any slip-up.

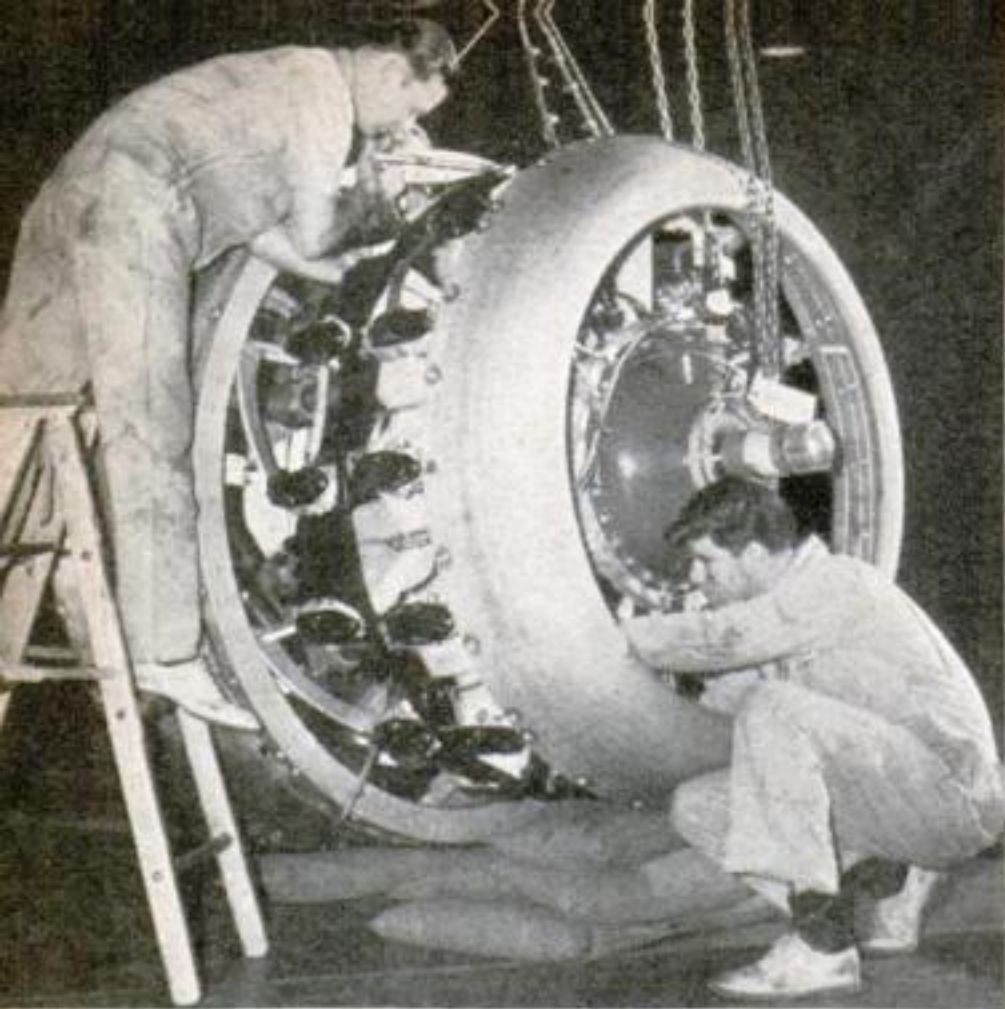
Cleaning crews, wearing soft window-dressers' shoes, run vacuum cleaners over a fifth of an acre of upholstery, scrub 65

After unloading, a launch tows the plane across 300 feet of water . . .

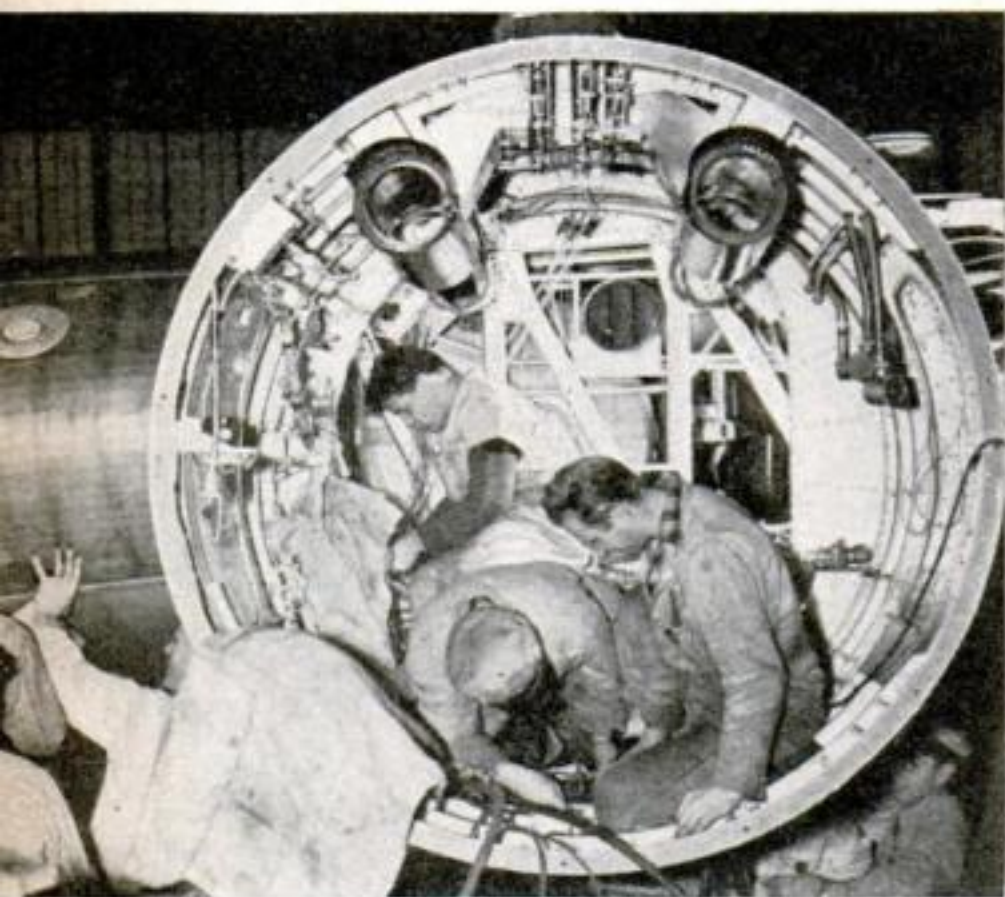
. . . to a ramp where electric winches and tractors pull it to the shore . . .

. . . and over a ¾-mile track to the hangar on a railroad truck





One of the 1,500-horsepower engines can be removed and another installed in less than four hours



This is the nacelle from which an engine has been removed. Among the thousands of spare parts kept at the New York terminal are complete tail surfaces (below) which can be installed during a turnaround



Getting the Clippers ready for winter involves putting on the biggest de-icing boots in the world

windows, wash 15,000 square feet of exterior metal and fabric. When working atop the 152-foot wings, the men wear safety belts attached to ropes. Recently they scraped 150 pounds of paint from the hull of each boat in the Atlantic service and replaced it with a light coat of protective lanolin. The weight saved permits an extra refugee child to be taken aboard on flights to America.

The greatest activity of all takes place on the immense three-story working platforms—one for each wing—which are wheeled into place as soon as the plane is in position within the hangar. Equipped with telephones, floodlights, compressed air, electricity, workbenches, office space, and even fire escapes, the platforms are well-equipped repair shops in themselves.

More than a year of experiment and research went into their design and construction. In the original laboratory work, Pan-American engineers used wooden blocks and a three-foot model of a Clipper plane to work out the most effective shape and size for the platforms. Six rubber-shod wheels, mounted so they compensate automatically for unevenness in the hangar floor, support the 30,000-pound work stands, and jacks incorporated in the framework anchor them in place. Their 2,000 square feet of floor space are covered with special nonskid linoleum. From the kerosene faucets, rag chutes, and spare-part cabinets on

Workmen wear flannel shoes to protect surfaces

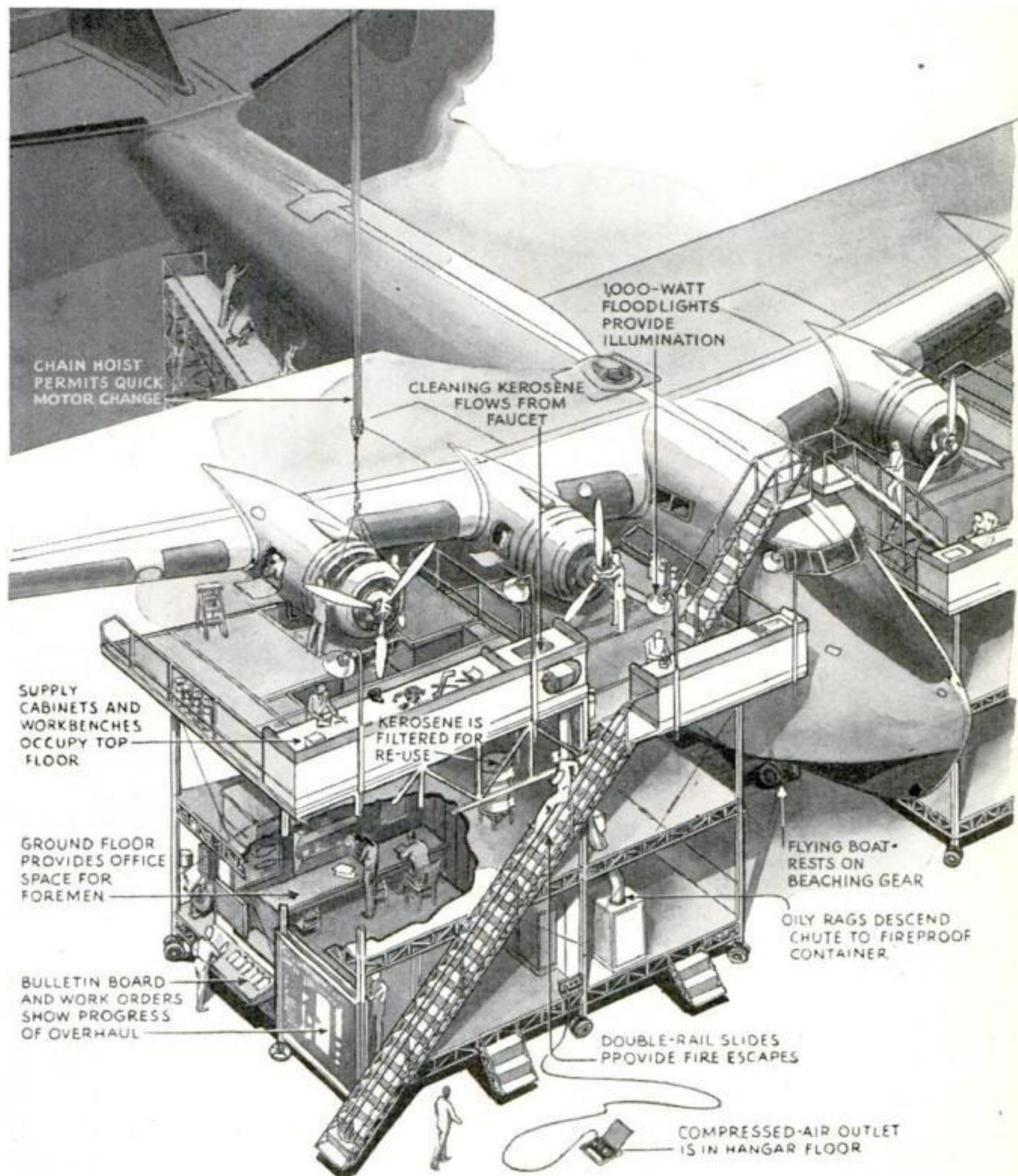


the top floor, to the office desks for inspectors and foremen on the ground floor, the unique platforms are designed for saving seconds—which add up into hours.

Another feature which has helped cut the time of a complete overhaul from more than a week to less than two days, is a vast supply of spare parts. Ready for instant use is everything from a bolt that costs a fraction of a cent to a huge hydro-stabilizer, or sea wing, worth \$24,000. New engines, new propellers, new tail surfaces, are all

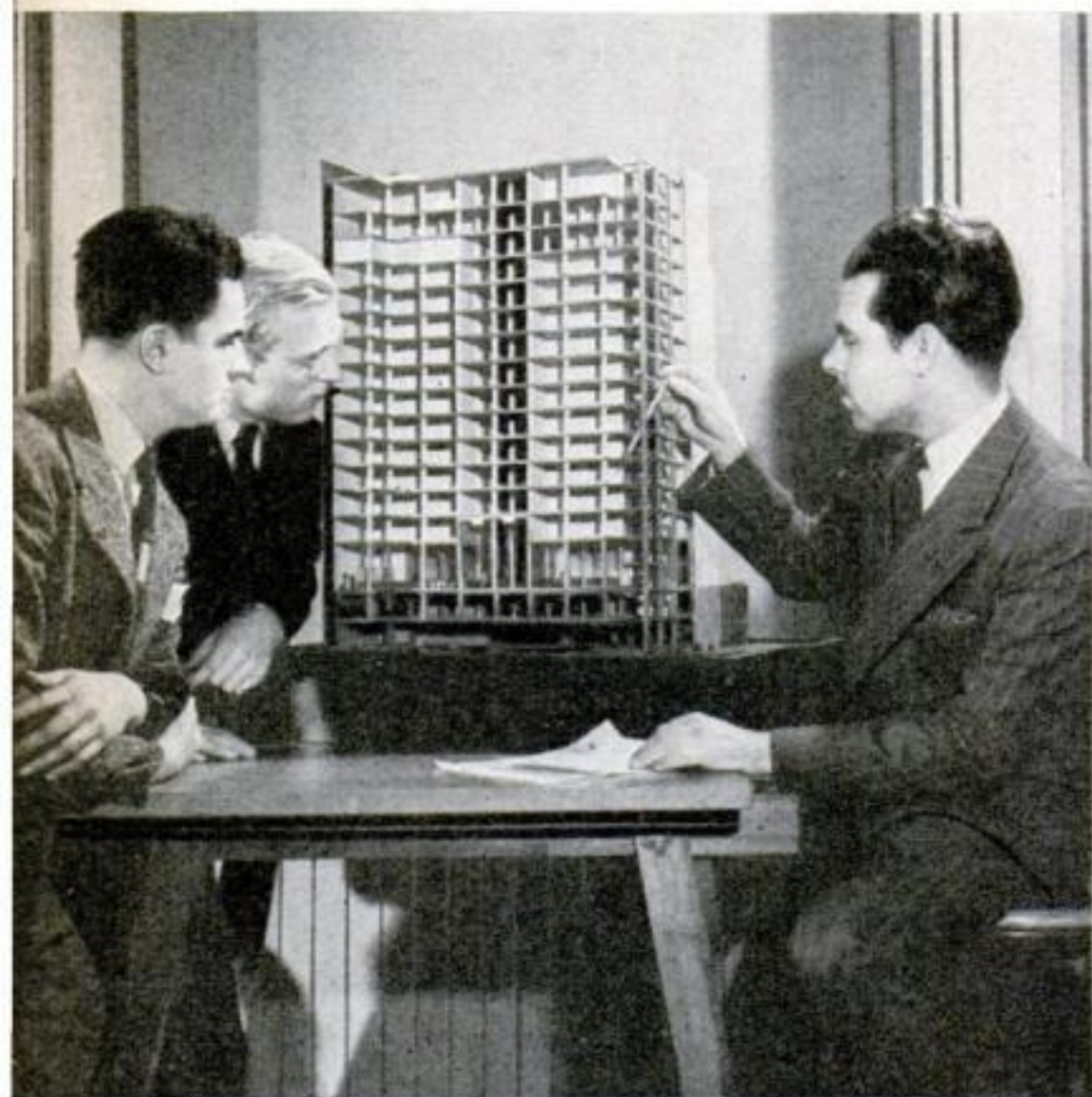
ready to be swung into place with a minimum loss of time.

At the end of each "two-day turnaround," the overhauled plane—whether it is the *Atlantic Clipper*, the *Dixie Clipper*, or the *Yankee Clipper*—takes to the air for a four-hour test flight before going back into commission. So successful have these high-speed groomings of the transatlantic planes proved that, it is reported, other companies are planning adoption of similar methods on the coast-to-coast air lines.



Working platforms—one for each wing—are complete workshops on wheels, with benches, spare-parts cabinets, and offices. There are connections for electricity, compressed air, floodlights, and telephones

Americans Study Air-Raid Safeguards

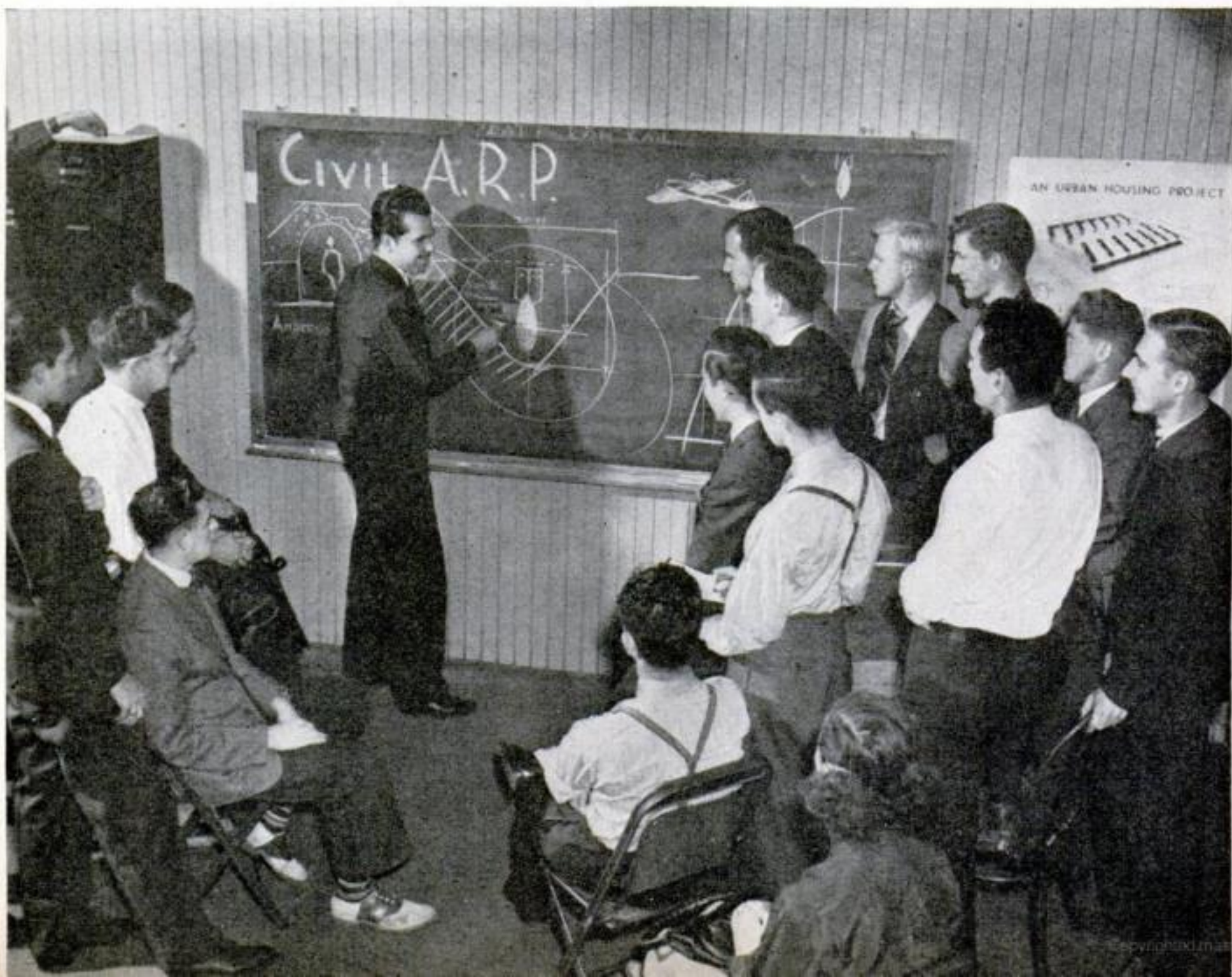


INVENTIVE minds, spurred by the ravages of aerial warfare abroad and guided by the grim lessons learned by stricken cities, are striving to make America as bombproof as any nation can be made in this day of death from the sky.

The answer to the question, "Has the protection of the civilian population against air raids been made a definite part of the defense program?" is a many-sided one which discloses that elaborate safeguards for the men, women, and children behind the lines are being arranged simultaneously with the measures for actual defense by the Army and Navy.

Civilians, assigned to the task by the War Department, are completing a master plan for fighting fires in bomb-wracked communities. Others have made preliminary designs for the

American architects and engineers learn how to build bomb shelters, from Erling F. Iverson at Pratt Institute, Brooklyn



world's largest bomb shelter. It would be seven stories high, built of massive concrete, big enough to hold 1,000 persons, and constructed with placements for anti-aircraft guns.

Still more brains are at work devising means for hospitalizing the wounded, for evacuating civilians, for assuring food supplies and first aid for those who stay in danger zones, and for maintaining the flow of life-preserving water in case of damage to mains and reservoirs.

Europe's travail gives warning to the rest of the world that bombs are of three types: gas bombs, designed to suffocate and kill every breathing being; explosive bombs, intended to blow up military objectives and to punish civilian morale by destroying factories and skyscrapers and tenements, and incendiary bombs, dropped both to start costly fires and to light the way for the planes that are loaded with explosive bombs.

For gas bombs, which are either too impractical or too inhuman to have figured greatly in Europe's current war, there is only the precaution of supplying the populace with masks. The possibility of gas-bombing of America is still remote enough to eliminate the need for haste in combating this problem. But against the threats of incendiary and explosive missiles, America is already arming.

That master plan for fighting incendiary weapons is being worked out to its last detail by the New York City Fire Department, under commission by the War Department. Right now the plan is a carefully guarded secret because the War Department fears that it might fall into the hands of a potential enemy, or that revelation of its spectacular nature might alarm timid civilians. But if war comes, this plan for all America will be released at once to all fire departments. Then there will be no frantic scurrying around by leaderless men, but efficient, cool action by men guided by a veritable "blueprint."

Fire Commissioner John J. McElligott is the leader in developing this master plan, and the task was assigned to him because the War Department knows that McElligott has the world's biggest fire-fighting job.

New York's 318 square miles include 578 miles of waterfront docks and piers on which enemy raiders would seek to concentrate. The city's skyscrapers are the largest anywhere. Its slums are among the



A hit on this British shelter caused one casualty in 70 occupants

worst in any metropolis. Its more than 800,000 buildings are worth \$21,000,000,000. Beneath its streets is an amazing tangle including 38,000 miles of electric power and cables, 500 miles of subways, 5,000 miles of gas mains, 645,000 miles of water pipes, and 9,500,000 miles of telephone lines.

With 10,000 members and 900 pieces of equipment, the New York Department puts out from 25,000 to 30,000 fires in a year. But bombing assaults, such as London has suffered, might set that many in two weeks!

Because of the dire possibilities, Commissioner McElligott's master plan for wartime calls for organization of an auxiliary force, not only large enough to guard the city block by block, but elastic enough to protect some blocks building by building.

Units of the force would be led by active or retired firemen or specially trained civilians. They would be centered near military objectives—railway stations, navy yards, arsenals, and factories—and in the slum areas. Their duties would be primarily to pounce upon incendiary bombs. To aid them, they would find sand and buckets and shovels distributed liberally about the city.

Another key point in the McElligott plan provides for establishment of a "mosquito fleet" of fire trucks, motor cycles, and private automobiles, to speed equipment to any disaster if streets become too littered to let huge hook-and-ladder trucks through.

But what if the fires grow to conflagra-



New York firemen get a lesson from the London Fire Brigade in combating damage by incendiary bombs

tions? What if explosive bombs wreck water mains that normally supply water for fighting fires?

McElligott's reply provides for the pumping of water from the rivers or the ocean. In recent tests his fire boats forced water through *one mile* of 3½-inch hose, and kept up a 75-pound pressure!

McElligott has rescue work in mind, too. His department has acquired a specially built \$15,000 truck, the best in the business for this purpose. It has a two-way radio and a public-address system for issuing orders. It has a five-ton power winch with 350 feet of steel cable to handle piled-up debris. It has a smoke ejector capable of clearing air at the rate of 5,500 cubic feet a minute. It carries asbestos suits for firemen, portable cutting torches, and hoses with special nozzles that foam up the water spray for use against oil fires.

Do all the devices

work? Well, McElligott, in 18 months devoted to compiling the master plan, has made actual tests at a proving ground after old buildings have been blasted and set afire with Army and Navy bombs. They work, all right, and today he believes he has the answer to every known problem of war-time fire fighting.

America's possible need for bomb shelters is something else again, but today there is one school where engineers and architects can study the technique of designing and building such structures. It is Pratt Institute in Brooklyn, and the instructor is Erling Iverson, a young Prix de Rome winner, who has studied bombs and shelters in Europe.

He believes that shelters here should be large and some distance apart, since civilians obviously would have more warning of raids, because of the distance enemy planes would have to fly, than do people in Europe, where the shelters must be placed within a minute's running time for everyone.

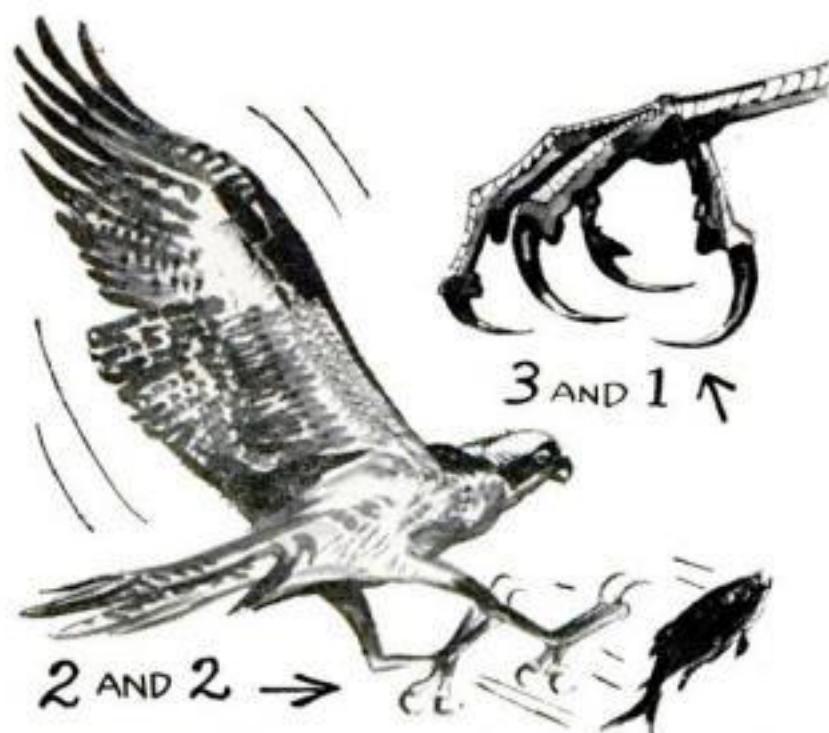
Iverson, discussing the seven-story shelter for 1,000 persons, is sure a concrete roof eight feet thick would resist any known type of bomb. The shelter would be windowless, to prevent shrapnel from crashing through, and would be ventilated with fans, lighted by electricity, and furnished with a kitchen and first-aid rooms. Its sturdy roof would afford a perfect base for an anti-aircraft crew, with sound detectors, searchlights, and artillery. During peacetime, Iverson believes, such a shelter could be used to store fire-fighting equipment, gas masks, and other necessary appurtenances of civilian defense. (*Continued on page 237*)



One of America's first bombproofs—a shelter for Edison's mementoes

Un-Natural History

BY
Gus Mager



THE OSPREY IS THE ONLY KIND OF HAWK THAT CAN REVERSE ITS OUTER TOE TO ARRANGE ITS CLAWS IN PAIRS LIKE THE OWL'S! ALL OTHER HAWKS USE THE 3 AND 1 COMBINATION!



NEAR COUDERSPORT, PA., IS A STRANGE **ICE MINE!** ON THE HOTTEST DAYS, THE FISSURES OF THIS CAVE ARE HUNG WITH ICICLES! WHEN COLD WEATHER COMES, THE ICE MELTS!



MEET THE HAIRY FROG! THE MALE OF THIS WEST AFRICAN SPECIES GROWS A FRINGE OF RED HAIRS ALONG HIS LEGS, LIKE A COWBOY'S CHAPS, TO MATCH THE WEEDS OF HIS NATIVE STREAMS!



MOST BIRDS' EYES ARE SET IN THE SIDE OF THE HEAD, BUT THE **OWL'S** FACE FORWARD! THE BARN OWL'S ARE IN REFLECTORS, TO GATHER DIM LIGHT AS IT HUNTS FOR MICE!

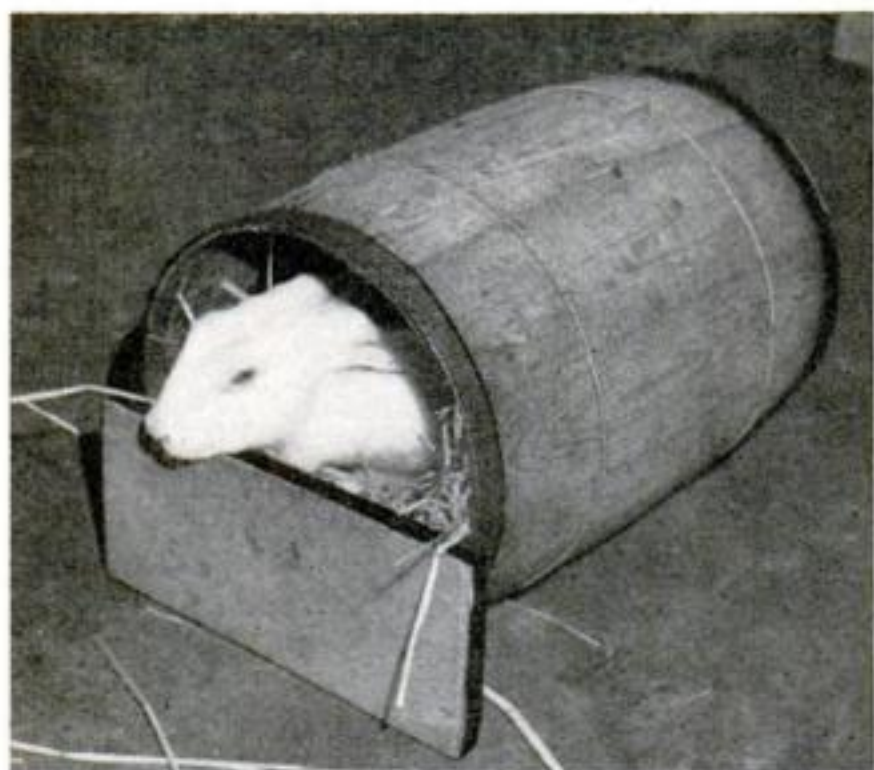
ON THE OTHER HAND, THE HUNTED **WOODCOCK**, WHOSE BILL IS OFTEN BURIED IN THE MUD, HAS HIS EYES FAR BACK TOWARD THE TOP OF HIS HEAD, TO WATCH FOR ENEMIES!



UNLIKE THEIR PARENTS, YOUNG **TAPIRS** ARE VIVIDLY STRIPED! YOUNG OF MANY ANIMALS DIFFER IN COLORATION FROM ADULTS!

Rabbit Cafeteria

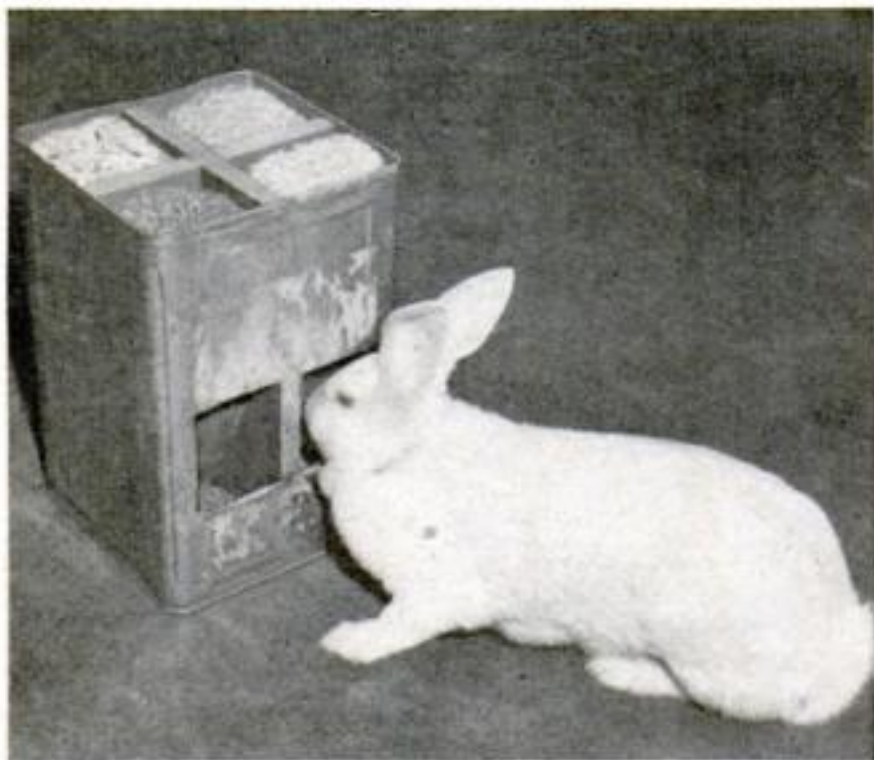
RABBITS aren't so dumb. At the U. S. Bureau of Biological Survey experiment station at Fontana, Calif., New Zealand white rabbits eat from ingenious "cafeteria-style" self-feeders which keep food before them at all times. Eleven years of study have shown that the rabbits know just what and how much to eat to grow up fatter and furrer. What they don't know is that this makes them ready for the roasting oven just that much sooner. Formerly, eight-week-old fryers weighed $3\frac{1}{4}$ pounds, now they top four. That means tenderer meat for the table and more profits for the rabbit raiser.



Between meals, rabbits at the U. S. Bureau of Biological Survey experiment station nest in nail kegs



Here's the market product developed by Uncle Sam: choice eight-week-old fryers ready for the skillet



A ten-pound New Zealand doe helps herself from a four-compartment self-feeder made from an oil can



Branding is a one-man job. A restraining box holds the bunny while the tattooing needles mark its ear

The Golden Throng — A New Book on Bees

BEES, "virtually the only insects which can be considered as domesticated by man," are the subject of Edwin Way Teale's "The Golden Throng." (Dodd, Mead & Co., \$3) The history and habits of these insects which have been living in co-operative and productive harmony since prehistoric times are presented in fascinating detail in this 200-page volume by the author of "Grassroot Jungles." Teale, a member of the staff of POPULAR SCIENCE, has illustrated the book with 85 photographs made during his months of observation of bees in their hives and in the fields. For camera fans interested in the insect world, the author has included a chapter on the equipment and methods used to obtain his remarkable photographs.



BEE THERMOSTAT is illustrated by this picture of bees pressing closely over the comb on a cool day, to warm it with their bodies. As day warms, they will disperse



BEE AIR CONDITIONER is the story here. The camera catches a bee's wings flapping to circulate fresh air within the hive



NECTAR HUNTERS. Another of the remarkable pictures in Edwin Way Teale's "The Golden Throng"

SCIENCE ON PARADE

IN "Science on Parade," (D. Appleton-Century Company, 314 pages, \$3) A. Frederick Collins offers a non-technical discussion of some recent scientific and engineering achievements. He describes the designing, construction, and uses of such varied items as the 200-inch reflector of the Palomar Observatory in California, transoceanic Clipper ships, and electronic pianos.

New Tools



PULL-CHAIN RATCHET WRENCH. Tightening and removing nuts is speeded up by a new type of socket wrench which has a pull chain in the handle. After the nut has started turning easily on the threads, a pull on the chain spins it rapidly. For tight work, the tool works like any ratchet wrench

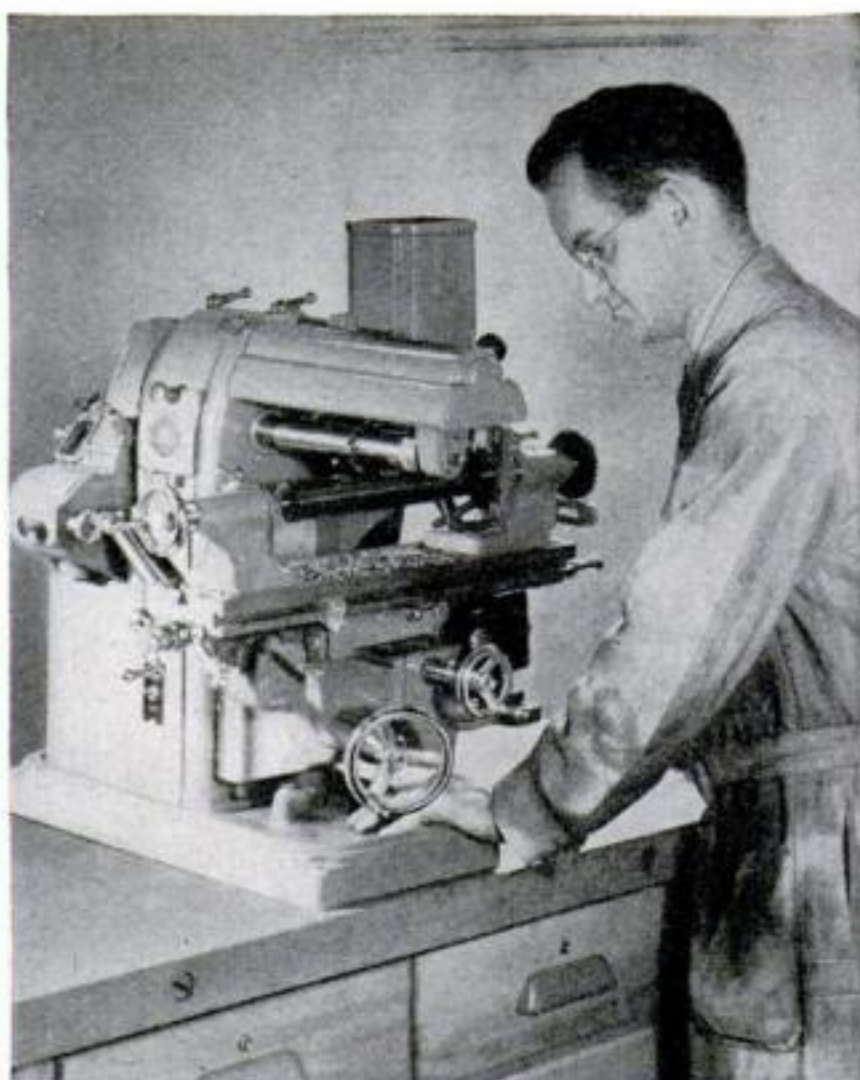
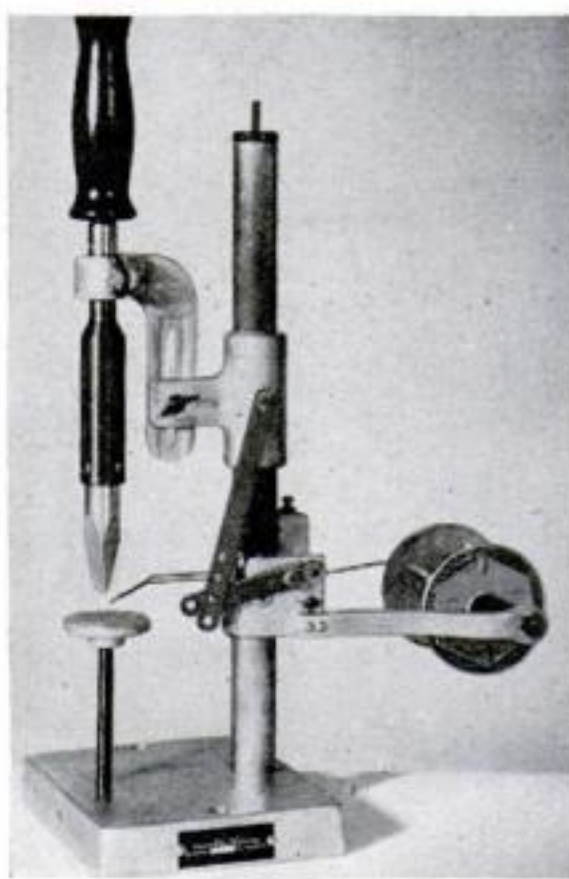


TABLE MILLING MACHINE. Small enough to be installed on a workbench, a compact milling machine has recently been placed on the market. Powered by a 1/3-horsepower motor, it has a working surface of 4 1/2 by 18 inches, longitudinal travel of 12 inches, and vertical travel of 6 inches



PLASTIC MALLET. Machinists will welcome this lightweight mallet fitted with hammering surfaces of plastic. When the ends become battered by use, it is an easy matter to unscrew them from the metal sleeve that holds them onto the handle, and replace them with new ones which can be readily obtained. While designed primarily for machine work, the tool should find many uses in the workshop

SHOE APRONS. Workers who handle chemicals, liquids, and foods can protect their shoes with "aprons" made of a synthetic material that resembles leather. Fitting over the vamp and upper part of the shoe, the covers can be cleaned by washing them with soap and water

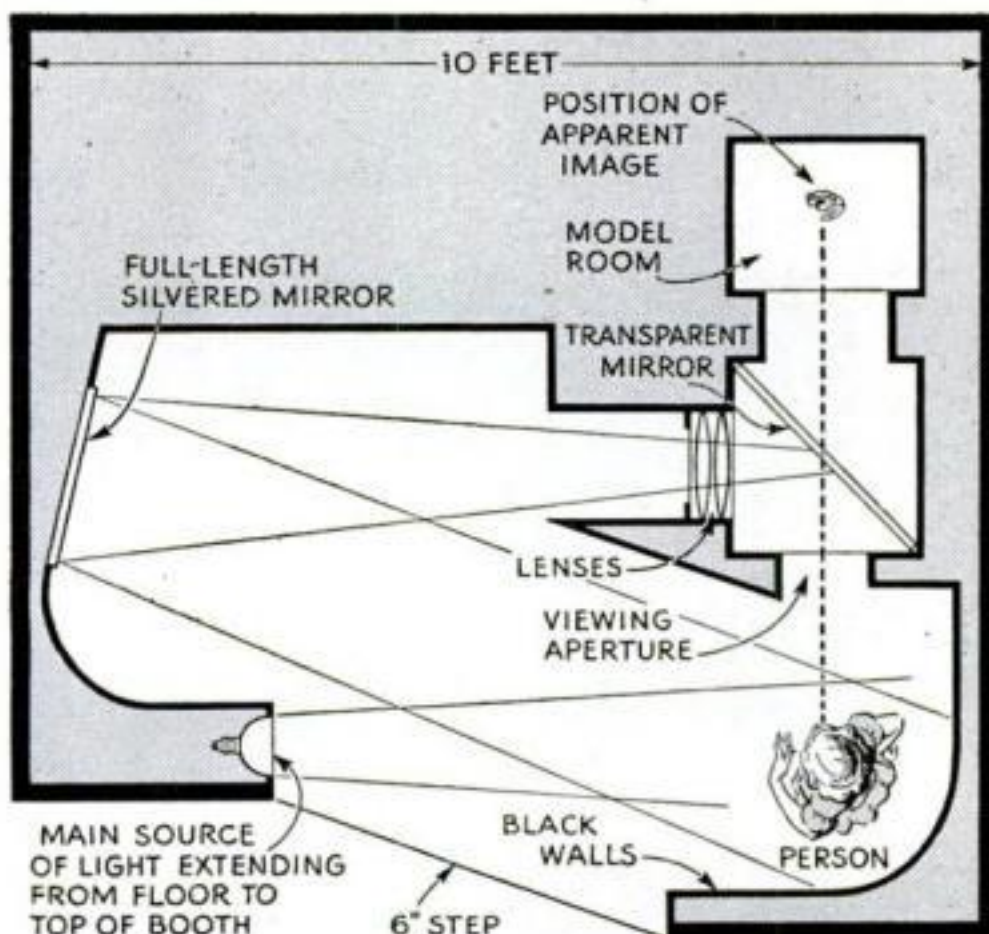
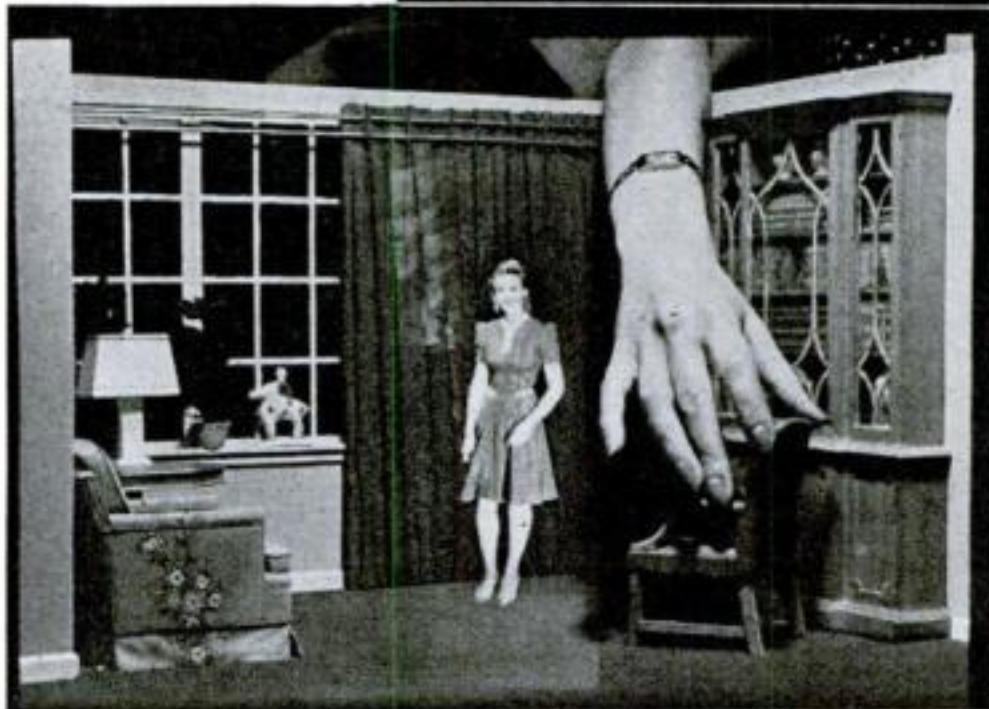


SOLDERING-IRON STAND. Speedy spot soldering is made possible by a special stand now available for use with soldering irons of any type. The iron is held above a small stage on which the material to be soldered is placed. Pressure on a handle lowers the iron against the work. At the same time, wire solder in sufficient quantity for the "weld" is fed from a reel attached to the stand

Rooms That Customers Can "Try On"

Here's how a visitor looks looking at herself from the black-curtained booth. She actually sees a miniature room, and herself apparently in it

The unusual effect below is gained as a hand intrudes in the setting to rearrange the furniture

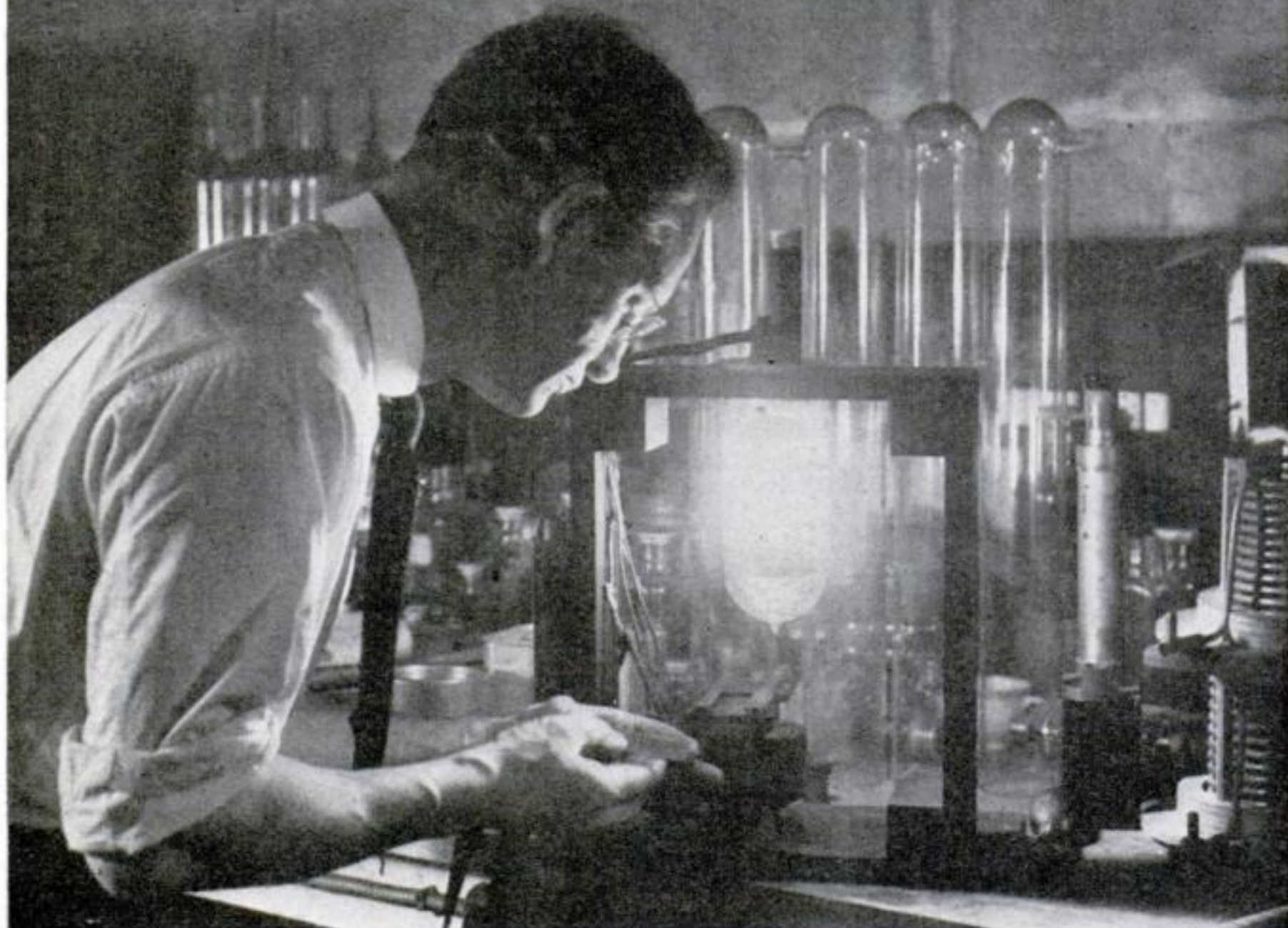


This is the layout of mirrors, lenses, and lights that does the trick. The "transparent mirror" is the real key

TO ENABLE visitors to see themselves as others see them amid different styles of interior decoration, a new booth at a home-furnishing center in New York City employs mirrors in the manner of a stage magician. When the visitor stands against a black panel in the booth and looks through a viewing aperture, she sees an image of herself, one eighth size, standing in a miniature furnished room.

The illusion is produced by a full-length silvered mirror set at such an angle in an opposite wall of the booth that it projects the image through lenses onto another sheet of glass set at an angle between the visitor and the model room. This glass forms a "transparent mirror," functioning either as a mirror or as a clear window according to whether the light in front of it is greater than that behind it, or vice versa. When the reflection from the full-length mirror is focused on this glass, the portion that receives the image acts as a mirror while the rest, because less light is reflected from the black panel to the silvered mirror than is given off by the lighting of the model room, remains transparent.

Cellar Scientist



Clifford A. Nickle at work in the cellar laboratory where he turns out anything from coffee to diamonds

By ROBERT PECK

IN THE middle twenties, when a lot of people were making playrooms out of their cellars, Clifford A. Nickle converted his into a laboratory. It turned out to be an excellent idea both for Nickle and for the General Electric Company, for which he is consulting engineer.

Nickle can turn his hand to almost anything today in his cellar laboratory—from the manufacture of diamonds to the brewing of coffee, each according to his own scientific formula and each with his own scientific equipment. The diamonds are not very good yet, but the coffee is excellent and in the last nine years 21 patents for devices in wide use in various industrial fields have resulted from Nickle's solitary cellar orgies.

He works alone, sometimes not emerging from the cellar of his home in Schenectady, N. Y., for days at a time. He will devote days, sometimes weeks, to assembling with his own hands the equipment necessary to

carry on his experiments. The corporation used to urge him to use assistants, but Nickle says that it is only by keeping busy with his hands that he can keep his brain functioning properly.



Twenty-one patents have come from this little shop

His associates in the General Electric plant see little of him. He emerges from his cellar at intervals only slightly more frequent than the winter ground hog, holds brief but illuminating conferences with his fellow research workers, and then pops into his cellar again. Production, engineering, and research heads of the corporation rely upon him to take almost any knotty problem into his burrow and emerge with a brilliant solution.

So far as they have discovered, the scope of his ability in the scientific field is almost unlimited. In a single year his patent applications covered such unrelated subjects as a magnetic core, noncorrosive soldering flux, aluminum reflectors, a coffee maker, a method for grinding optical mirrors, a time-delay switch, a method for making abrasive material, lampblack as a heat insulator, and a carbon microphone.

Much of his early work on the behavior of synchronous motors constituted a valuable contribution to the modern systems of providing light and power for industry and the home, and he was influential also in the development of traffic timers and other special small motors. For such work the General Electric Company gave him the Coffin Award, its highest decoration for original work by an employee.

Application of discoveries made by Nickle were important in the development of the new fluorescent lights, which are about three times as efficient as incandescent lights.

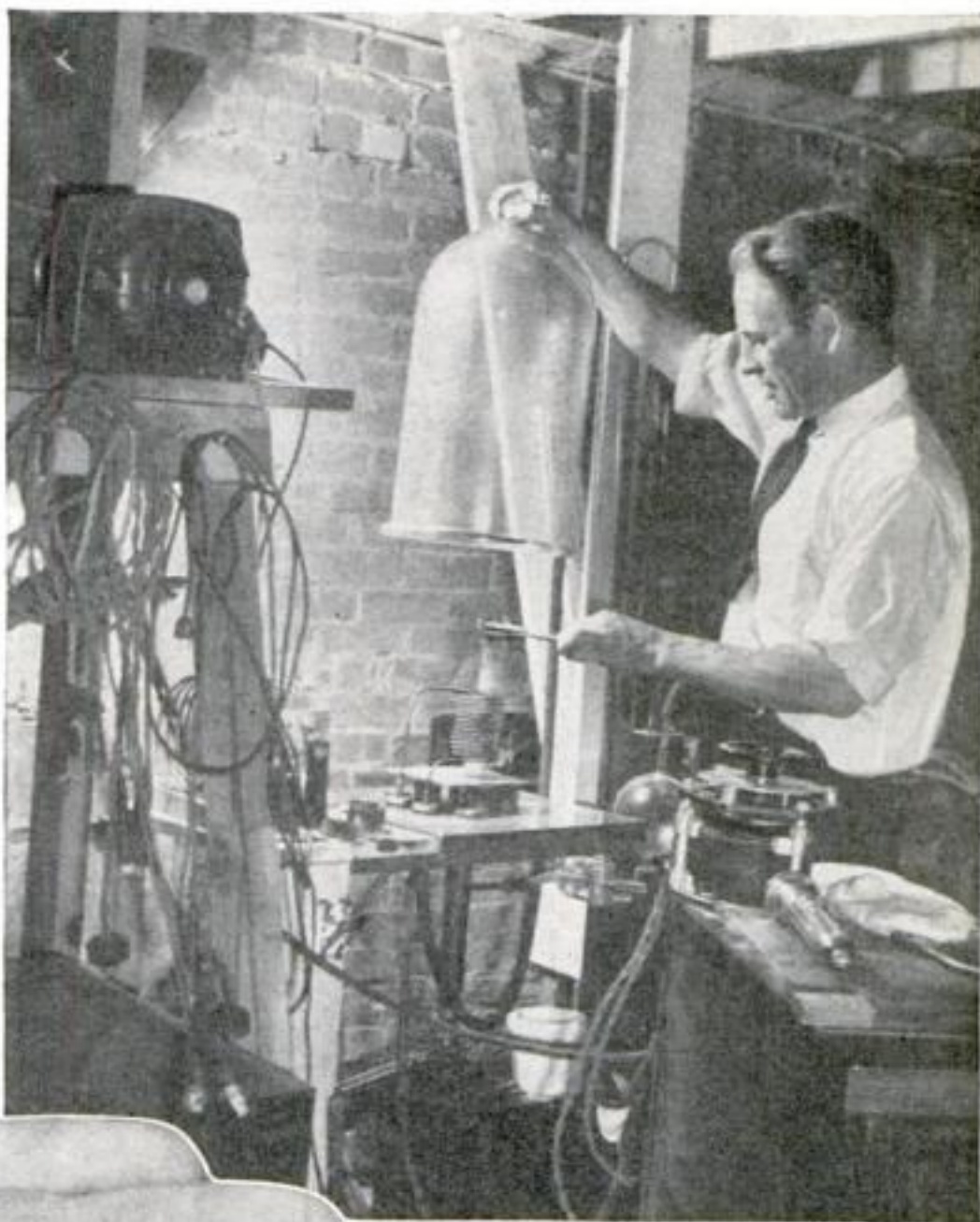
Research laboratories of the corporation were busy a few years ago seeking to improve the process of manufacturing ignitron tubes. In the transformation of alternating current to direct current these tubes perform somewhat the same function as a spark plug in an automobile engine. They must flash sixty times a second, almost 2,000,000,000 times a year.

Nickle went down in his cellar with the problem and came up three months later with an entirely new process by which the produc-

tion of the igniter, the heart of the tube, was transferred from the laboratory to a mass-production basis. The method has been adopted in the manufacturing of welding-control equipment widely used in the automotive and other industries, and some of the tubes have withstood several years of uninterrupted service. Nickle's methods of control for the welding of extremely fine wires of rare metals, in which the wires are heated without melting, are important in the manufacture of vacuum tubes and lamps.

Working with E. E. Johnson, then of the General Electric Research Laboratory, Nickle conducted experiments which resulted in the improvement of the inductotherm or "fever machine." It was through their work that it became possible to apply the heat locally instead of treating the entire body.

Nickle, in the midst of his intense research in industrial fields, during which he sometimes was in his cellar laboratory for days and nights on end, became convinced that there was a better way of making coffee than any so far devised and took a



With an electric-induction furnace of his own design, capable of producing temperatures above 6,000 degrees F., Nickle created particles of synthetic diamond



few weeks off to consider the subject. The result was a pressure coffee-maker, with which he turns out freshly made coffee as the need arises.

Much of his time is devoted to working with alloys in a search for compounds of greater hardness, high limit of elasticity, or greater strength. For the furtherance of this work he designed and built a high-frequency furnace capable of producing temperatures exceeding 6,000 degrees Fahrenheit.

It was while working with such high temperatures that he switched from coffee making to diamond making. Artificial diamonds had been made years before, but Nickle believes that the method can be perfected at least to the point where diamonds for industrial use can be turned out on a commercial basis. So far he has achieved only what he calls "diamond dust," though the product is a good deal coarser than dust and is more like sand.

In his work on high-frequency furnaces Nickle has developed also a control, used widely now in iron foundries, by which temperatures of the order of 1,500 degrees



Nickle aided in the development of fluorescent lighting

centigrade may be held automatically to within three or four degrees of a desired point. Such control is particularly useful when metals or alloys are to be brought close to the melting point without actually melting.

As if metallurgy, physics, and chemistry were not enough, Nickle turned a few years ago to astronomy as a minor hobby and built himself a five-foot telescope of 200 power, machining all the parts and grinding the mirror himself. He uses it now and then for both observation and stellar photography, the camera being another of his minor hobbies.

He is a pretty good golfer, too, and when he is feeling right can shoot eighteen holes in the seventies. Fishing, however, is his favorite relaxation. A good fishing day is one of the few rivals his cellar laboratory has. He is an expert angler but, to his mingled disappointment and delight, has not yet succeeded in reducing the art to a science.

He has tried his hand at it, though. In a world which bristles with artificial lures of every hue and shape, including transparencies equipped with a minute electric light and dry cell, Nickel has undertaken to turn out something new and irresistible. So far he has succeeded only in turning out something new. Like so many plain, unscientific anglers, he has made the discovery that fishing is replete with variables and unaccountables.

Born in Sharpsville, Pa., of Pennsylvania Dutch parents, Nickle showed an early interest in electricity and worked for four years as a repair man before entering Penn State College, where he had the highest general average that had ever been made there. After serving as an instructor in the U. S. Army Signal Corps during the World War, he joined the General Electric staff.



Taking up astronomy as a hobby, he built a 200-power telescope, making the mirror and all parts

Vitamins at \$1 a Year

NUTRITION experts believe that the day is near when a shopper may stop in at the corner grocery and tell the clerk:

"I'd like 6,000 units of Vitamin A, please. And while you're about it you might as well give me 750 units of Vitamin B₁, too."

The obliging clerk will not wrap up vitamins in their "raw" form, of course. But he will supply staple foods to which the usually missing vitamins and minerals have been restored. When that day comes, the dieticians agree, Americans will be on their way to becoming a healthier, stronger, and longer-lived people.

This shopping-for-health program, which might have seemed fantastic only a few months ago, came nearer to reality after British authorities recently decreed that Vitamin B₁ and calcium must be added to all flour milled in England.

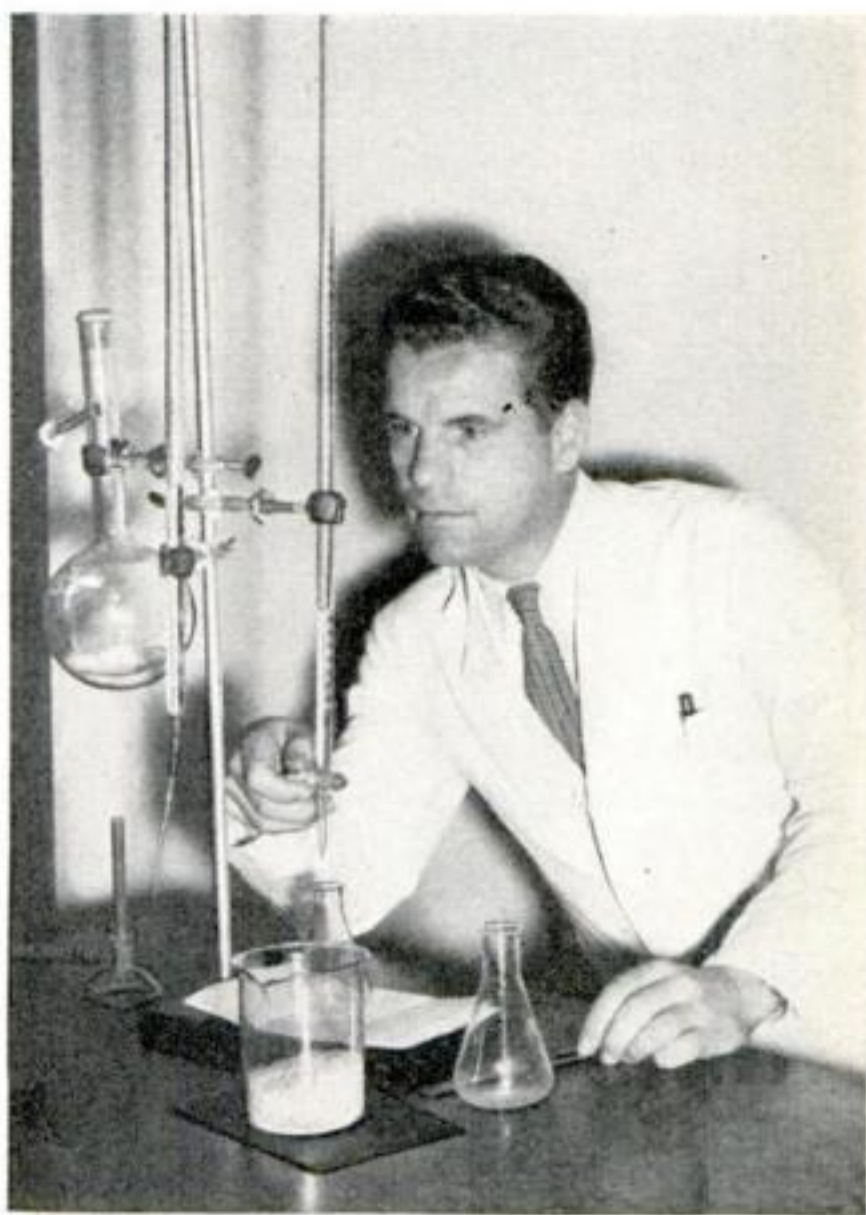
Scientific minds in America were already working on similar proposals, both to provide such elements to men in the military services and to spread the benefits to all undernourished civilians.

At the California Institute of Technology a conference on nutrition submitted a plan to the National Defense Council under which staple foods could be "fortified" at a cost of about \$1 a year a person. One who approved was Harriett Elliott, consumer representative on the Council, who contends that 45,000,000 Americans live on the borderline of undernourishment. She named an advisory committee to study the possibility of fortifying flour as the British do. The big millers are considering it, too.

There's not much danger of anyone getting an overdose of vitamins. An individual weighing 150 pounds requires 6,000 units of Vitamin A every day, but can take 200,000 units without deleterious effects. He'd have to swallow 14,000,000 units at once to commit suicide. The same man may need 750 units of Vitamin B₁ a day, yet for a year and a half experimenters at Caltech received 33,000 units a day without suffering in health.

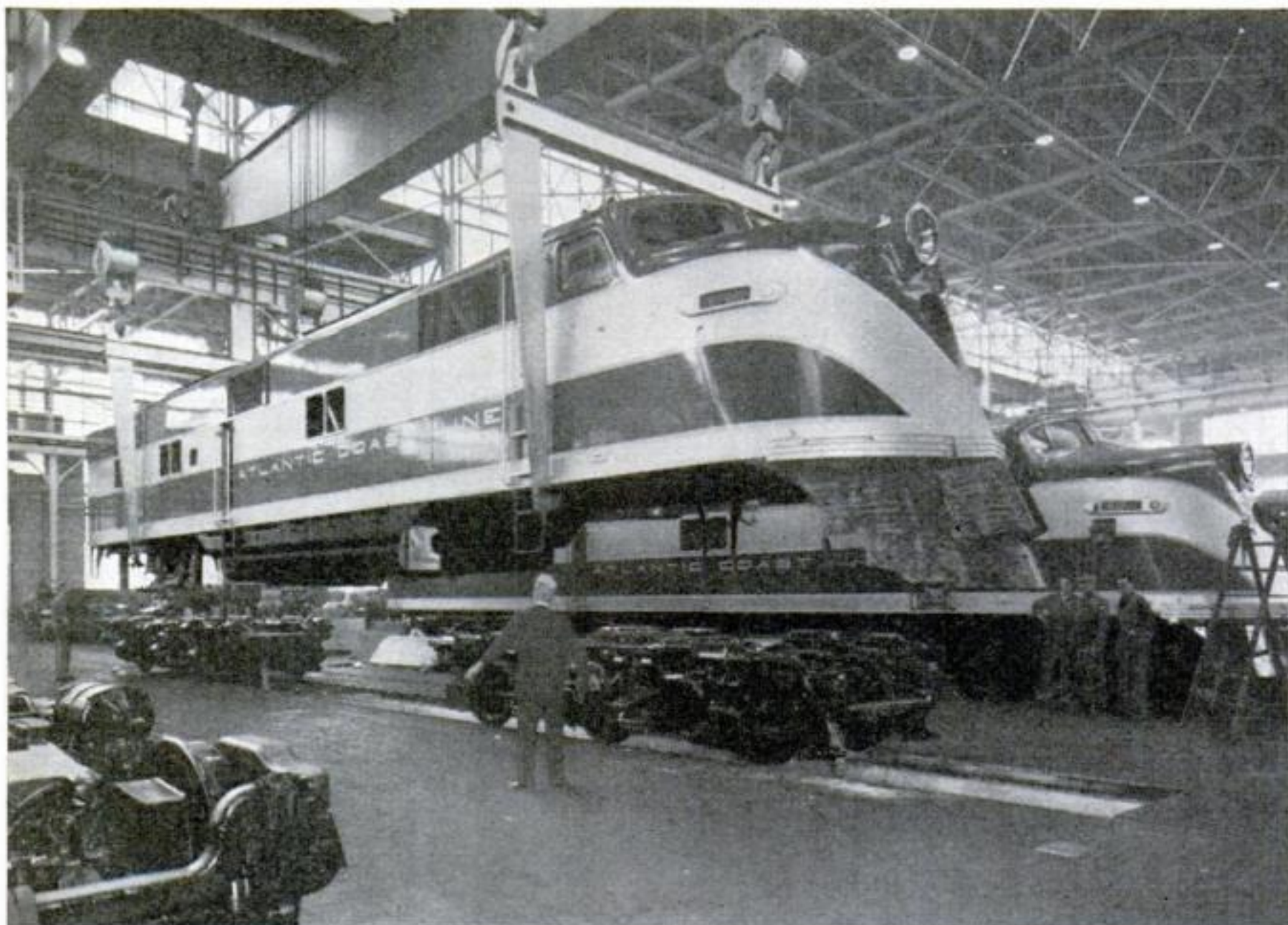
Another vitamin-rich food is the "cereal" developed by Dr. Robert S. Harris, of the Massachusetts Institute of Technology. It includes wheat, corn, oats, soy-bean meal, skim milk, and a concentrate of vitamins. It supplies every vitamin except C. Less than an ounce of the cereal, added each day to the ordinary diet, would cost \$1.87 a year.

So, the dinner-table request of the future may be: "Please pass the vitamins."



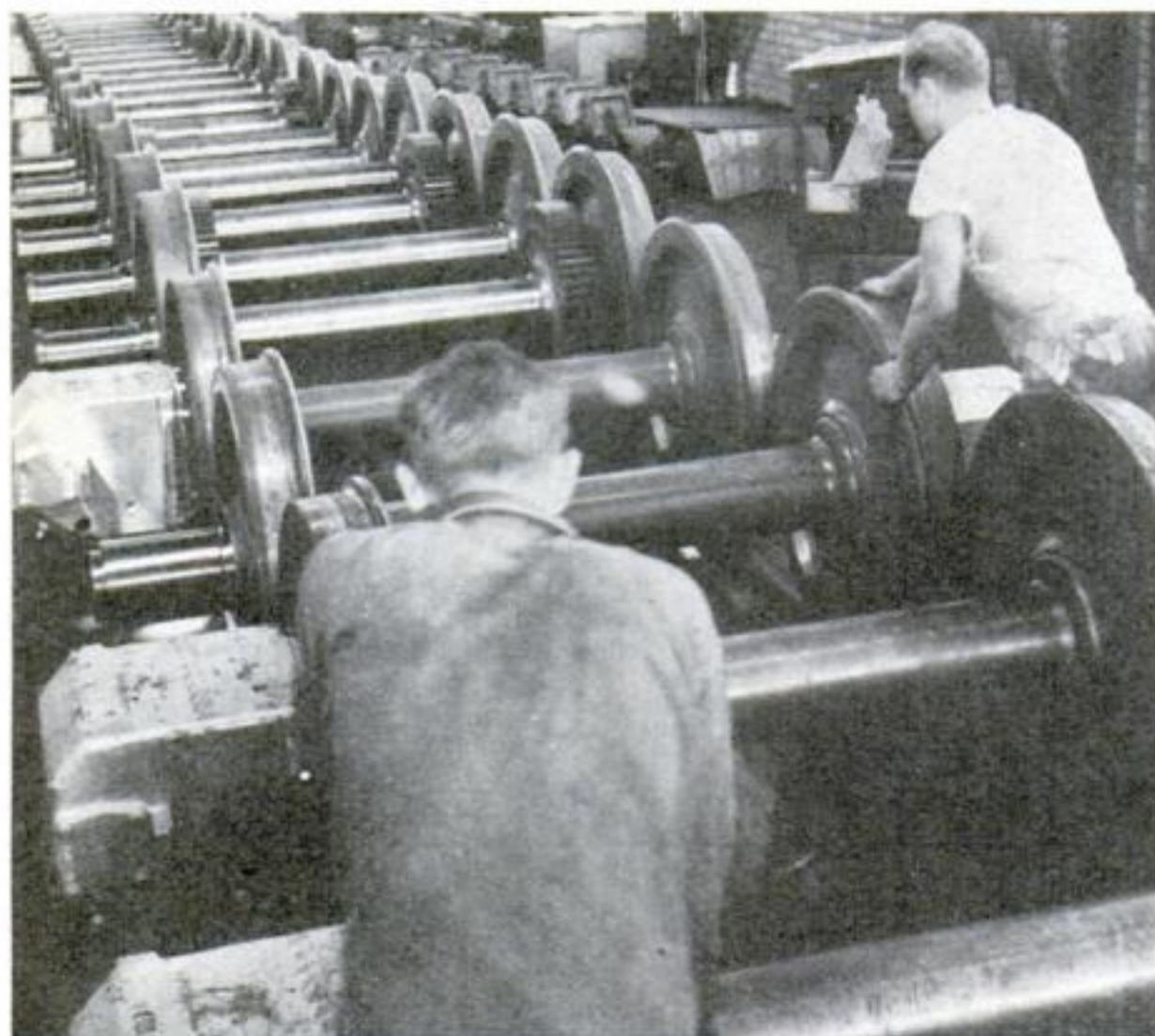
HEALTH FROM THE TEST TUBE. Dr. Robert S. Harris, of the Massachusetts Institute of Technology, has developed a "cereal" rich in vitamins

ONE OUNCE A DAY of this formula, added to the regular diet, provides all the vitamins needed. A year's supply would cost only \$1.87



"Trucking" one of the 18 Diesel-electric railway locomotives being built for the Atlantic Coast Line

The Ever-Increasing Assembly Line

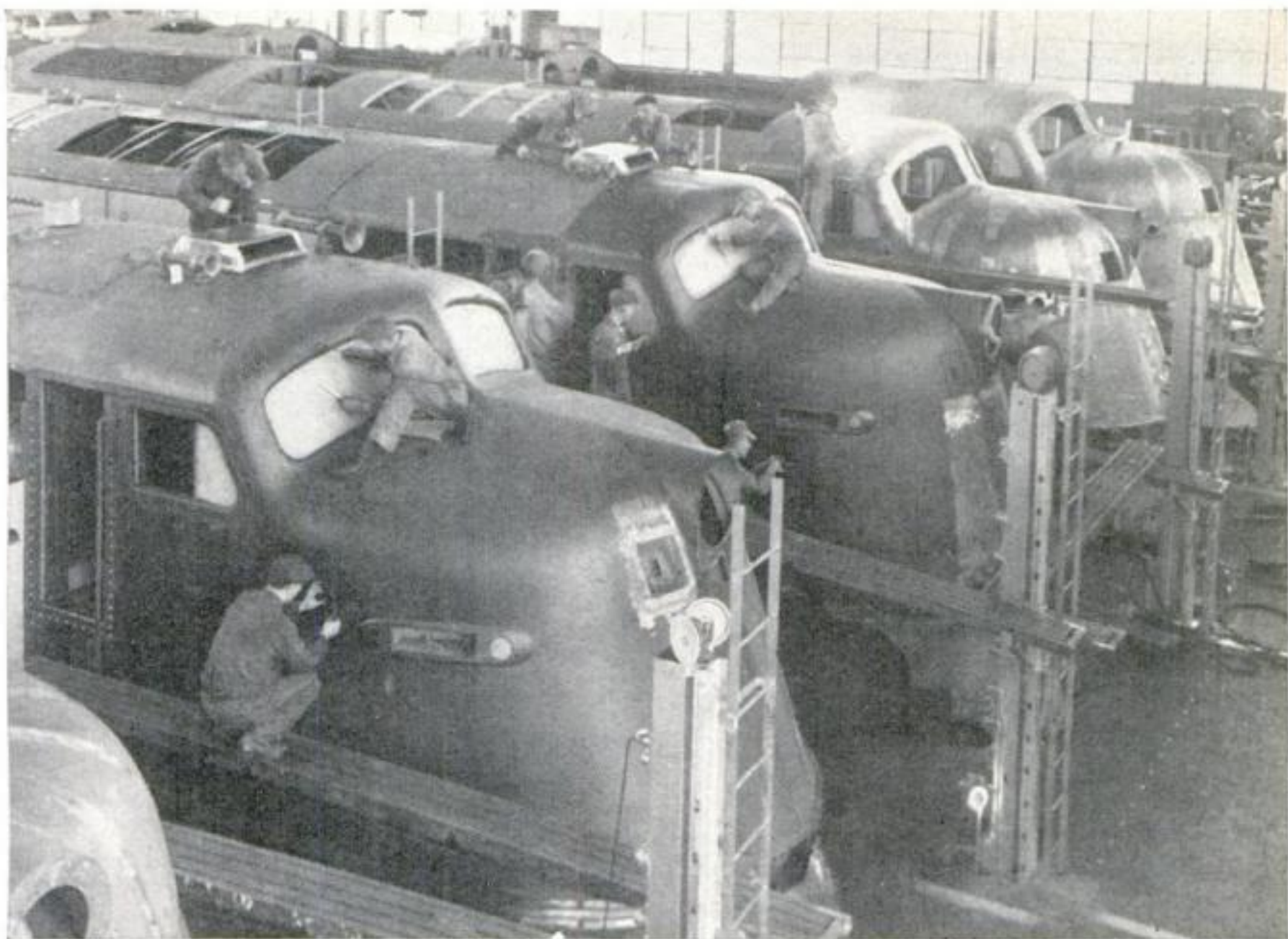


Wheels and axles roll on the assembly line of a La Grange, Ill., plant

LOCOMOTIVES are now being built by mass-production methods. Using the assembly-line technique for which American industry is famous, workmen are toiling 24 hours a day to complete 18 new 2,000-horsepower Diesel-electric engines that will soon be rolling the rails in the Atlantic Coast Line's fast New York-to-Florida service.

Constituting the largest order ever placed in the United States for this type of railroad power, the locomotives are being built at the La Grange, Ill., shops of the Electro-Motive Corporation.

Each of these oil-burning giants is built around two 1,000-horsepower, V-type 12-cylinder engines.



Workmen swarm on the cabs of 2,000-horsepower giants that will drag crack New York-to-Florida flyers

They are the same type that is being used in many of the Navy's new submarines. In the locomotives, each engine is hooked to a 600-volt, direct-current generator from which power is carried in heavy cables to four traction motors, two in each truck.

Weighing 310,000 pounds when fully loaded, each unit carries enough fuel for a 600-mile run. In service, the same locomotive will remain at the head of a train for the entire run of 1,160 miles between Washington and Miami. For unusually heavy trains, two or more of the locomotives may be hooked together.

Though Diesel power is the motive force, steam, king of the rails for more than 100 years, still plays a part in these new locos. Each unit will carry 1,100 gallons of boiler water for steam-heating the trains.

Operation of Diesel-electric locomotives is in essence simpler than driving a car, as the engineer uses only a control like that of a trolley car, and an air-brake lever. Red, green, and orange lights on an instrument panel warn the engineer of possible troubles, such as low oil pressure or an overheated engine or boiler. If anything does go wrong, an eight-inch electric gong in the engineer's cab starts clanging a

warning, and doesn't stop until the trouble is corrected.

To illuminate the right of way and warn cars at grade crossings of the oncoming train, the locomotives will be fitted with 500,000 candlepower "Mars Light" headlights. These lights have been seen for a distance of twenty miles at night.

Powerful locomotives of this type will speed industrial preparedness by increasing transportation facilities.



These are finished pistons for the 12-cylinder engines



Here's My Story

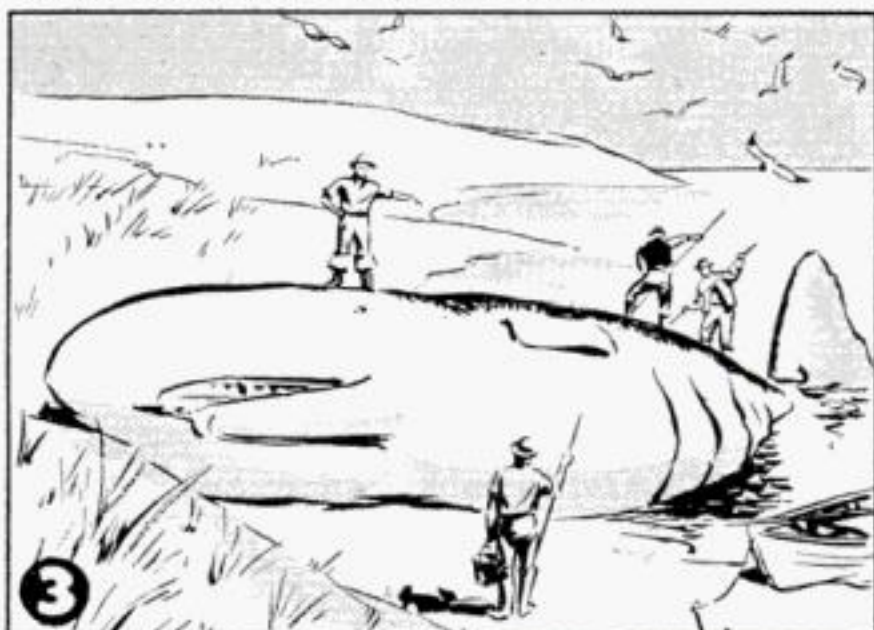
ROY CHAPMAN ANDREWS WAS BORN IN BELOIT, WIS., ON JANUARY 26, 1884



1 ALWAYS INTERESTED IN NATURAL HISTORY, ANDREWS WAS AN ACCOMPLISHED TAXIDERMIST BEFORE HE FINISHED GRAMMAR SCHOOL. HE EARNED MOST OF HIS COLLEGE EXPENSES STUFFING BIRDS AND ANIMALS



2 HE LEFT HOME IN 1906 AFTER GRADUATION FROM BELOIT COLLEGE, AND, WITH ONLY \$30 IN HIS POCKET, CAME TO NEW YORK TO SEEK A JOB WITH THE AMERICAN MUSEUM OF NATURAL HISTORY



3 TO TEST HIS SKILL, ANDREWS WAS TOLD TO GET FOR THE MUSEUM A TWENTY-TON SULPHUR-BOTTOM WHALE WHICH HAD BEEN WASHED ASHORE ON LONG ISLAND. THE WHALE'S SKELETON STILL HANGS IN THE MUSEUM



4 HE HUNTED AND STUDIED WHALES FOR EIGHT YEARS, AND THEN LED MUSEUM EXPEDITIONS TO TIBET, BURMA, AND MONGOLIA



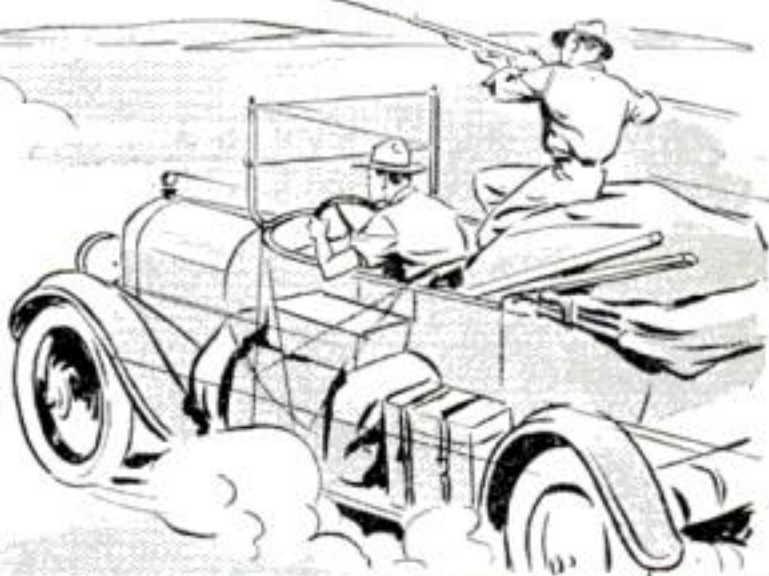
5 IN 1921 HE ORGANIZED THE LARGEST LAND EXPLORING EXPEDITION EVER TO GO ABROAD FOR THE MUSEUM. IT WAS THE FIRST TO USE AUTOMOBILES FOR EXPLORING UNCHARTED AREAS OF THE BLEAK GOBI DESERT

THE CAREER OF ROY CHAPMAN ANDREWS



B.W. SCHLATTER

6 ANDREWS FRIGHTENED OFF ONE OF THE MANY BANDIT PARTIES THAT THREATENED TO ATTACK A LATER EXPEDITION BY DRIVING TOWARD THEM IN A CAR AT FIFTY MILES AN HOUR, FIRING RIFLES OVER THEIR HEADS



7 TO LEARN THE SECRET RELIGIOUS RITES OF THE LAMAS, HE DISGUISED HIMSELF AS ONE OF THEM AND ENTERED A MONGOLIAN TEMPLE WHERE NO WHITE MAN HAD BEEN BEFORE

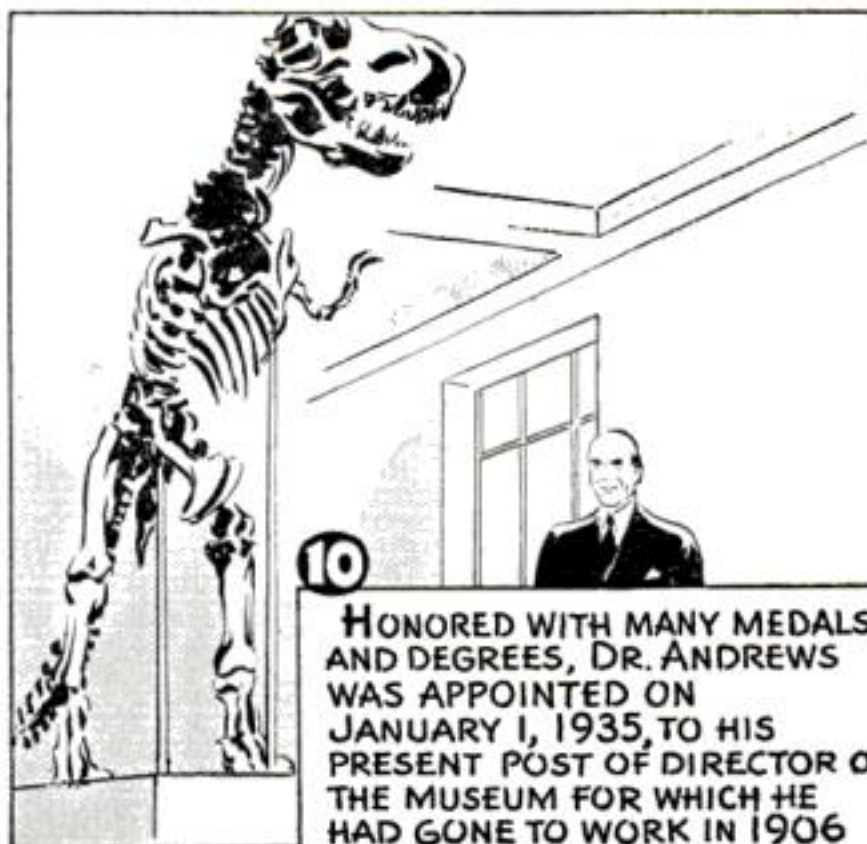


8 HE CAME CLOSE TO DEATH IN 1928 WHEN HE ACCIDENTALLY SHOT HIMSELF IN THE THIGH WITH HIS OWN AUTOMATIC WHILE IN THE HEART OF THE GOBI DESERT



9 THE EXPEDITIONS, WHICH ENDED THEIR WORK IN 1930, WERE THE FIRST TO FIND DINOSAUR EGGS AND THE SKULLS AND BONES OF THE BALUCHITHERIUM, LARGEST KNOWN MAMMAL. THEY MAPPED MUCH PREVIOUSLY UNKNOWN TERRITORY

FEBRUARY, 1941



10 HONORED WITH MANY MEDALS AND DEGREES, DR. ANDREWS WAS APPOINTED ON JANUARY 1, 1935, TO HIS PRESENT POST OF DIRECTOR OF THE MUSEUM FOR WHICH HE HAD GONE TO WORK IN 1906

Death Chamber Destroys Alien Insect Invaders

FOREIGN insects and plant diseases have a new barrier to hurdle before they can launch an attack on American flora. It lies in the recently opened plant-quarantine inspection house of the U. S. Bureau of Entomology and Plant Quarantine at Hoboken, N. J.

Eighty-five percent of certain categories of imported plant material suspected by the Department of Agriculture of bringing new plant troubles into the country is sent to the Hoboken inspection station. There, in 12 rooms sealed to prevent possible escape of harmful insects, trained entomologists and plant pathologists, clothed in sterilized gowns and gloves, give the imported material a thorough going-over.

Giant tanks are used for fumigating large lots of contaminated material under pressure or vacuum, as desired. They can also be used to steam-sterilize the soil in which plants are shipped. Smaller tanks are used for de-bugging small quantities of material so that the handling of the large shipments will not be interrupted. Vats are provided in which plants may be treated to hot-water baths, while refrigeration units are used to kill any bugs or germs susceptible to such treatment.

Plants that are still diseased after one or all of these treatments may have to be destroyed. Those that are deemed clean and healthy are carefully aired to remove any trace of poisonous fumigating gases or powders before they are shipped on their way.



A masked worker lifts plants from a death chamber



Sealing a big vault before poison gas is admitted

Question Bee

Each correct answer earns ten points, and a score of 70 is good. Check your results with the list below

- 1 If you slide down the banisters, look out for a collision with the (a) king-post (b) newel (c) mullion (d) lintel.
- 2 Liquid wax should be (a) applied to floors (b) poured down clogged sinks (c) mixed with garden soil.
- 3 A leaky faucet probably needs a new (a) float (b) washer (c) trap.
- 4 The dampers of a furnace (a) regulate the humidity (b) spray ashes with water to lay the dust (c) control the rate of combustion.
- 5 Horizontal beams in floors are known as (a) studs (b) joists (c) rafters.
- 6 To make a right-angle turn in piping, a plumber uses a fitting called (a) a knuckle (b) an elbow (c) a neck (d) a knee.
- 7 An oil-burner installation should be provided with (a) an octane selector (b) a thermostat (c) an alarm siren.
- 8 The short, upright boards in a flight of stairs are called the (a) quoins (b) treads (c) risers (d) pilasters.
- 9 Storm sashes are used to prevent (a) rain from entering (b) heat from escaping (c) lightning from coming in.
- 10 A typical hot-water heating system has (a) a settling tank (b) a gasoline tank (c) an expansion tank (d) a ballast tank.

ANSWERS

- | | | | | |
|------|------|------|------|-------|
| 1. b | 2. a | 3. b | 4. c | 5. b |
| 6. b | 7. b | 8. c | 9. b | 10. c |

BACKYARD CITY

MORE than 60,000 persons, in the past three years, have visited Chesterton, Ind., (pop. 2,231), to look at William Murray's back yard. It is the site of Littleville, the most elaborate one-man, midget city in America. Built to Lilliputian scale, there are hotels, hospitals, homes, churches, factories, theaters, restaurants, garages—125 realistic buildings arranged to form a model community.

Littleville started as a single bird house in 1932. Murray, who works in a steel mill near Gary, constructed the house in his basement workshop. As he was preparing to place it on a pole, he was struck by the realistic appearance of the little house as it rested on the lawn. So, Murray anchored it in place and began to surround it with other model buildings turned out during his leisure time. Simple houses came first, then a stone mill, then a church which required 308 hours to complete. Before long, Murray was making regular trips to Valparaiso to bring home loads of orange crates and apple boxes as a supply of raw material.

By 1938, the project had assumed such proportions that people for miles around were bringing visitors to see the midget city. A local newspaper ran a feature article on "The Fastest Growing City in America." In that year, 1938, Murray

Billboards attract thousands of visitors annually

opened his back yard to the public, charging a five-cent admission fee. He was amazed when, during the first year, 20,000 visitors flocked to Littleville. In 1939, 33,000 came, and, during the past summer, cars from a dozen different states often lined the street on which he lives. You can find in the Littleville Register the names of visitors from Canada, Australia, Japan, and Europe, as well as from every state in the Union.

As these visitors have wandered along the narrow streets of Littleville, they have seen everything from a haunted house—where the cobwebs produced by lawn spiders are

William Murray, founder of Littleville, putting the finishing touches on a store building to be added to the business district of the miniature metropolis



Young visitors examine some of the 125 buildings

A modern Gulliver bestrides the old mill stream



LITTLEVILLE
AMERICA'S
BIGGEST (MINIATURE)
TOWN
TURN LEFT
AT STOPLIGHT
THEN
11 BLOCKS WEST CHESTERTON
3 BLOCKS SOUTH IND.

never removed—to a jail and a courthouse, a country club and a waterfront. There is an airport with hangars and planes. There is a "Littleville Post Office" where visitors can mail letters and post cards which are stamped with the name of the miniature city. There is even a "Littleville News," a twelve-page, pintsize paper that carries both advertising and news stories.

In 1939 a railroad, 75 feet long, which actually is operated, was built in the town. Among the additions last year were a school, an oil station, a power house, an airport, and several new houses.

An interesting feature of Murray's backyard project is the fact that it is the only city in America which is covered by insurance issued by a single company. A couple of years ago, Murray took out a \$2,000 fire-and-tornado policy on his growing collection of buildings. In June 1939, he nearly collected on the tornado clause. A twister damaged real houses not far away. But it merely tossed a few of the light Littleville structures around without doing any appreciable damage.

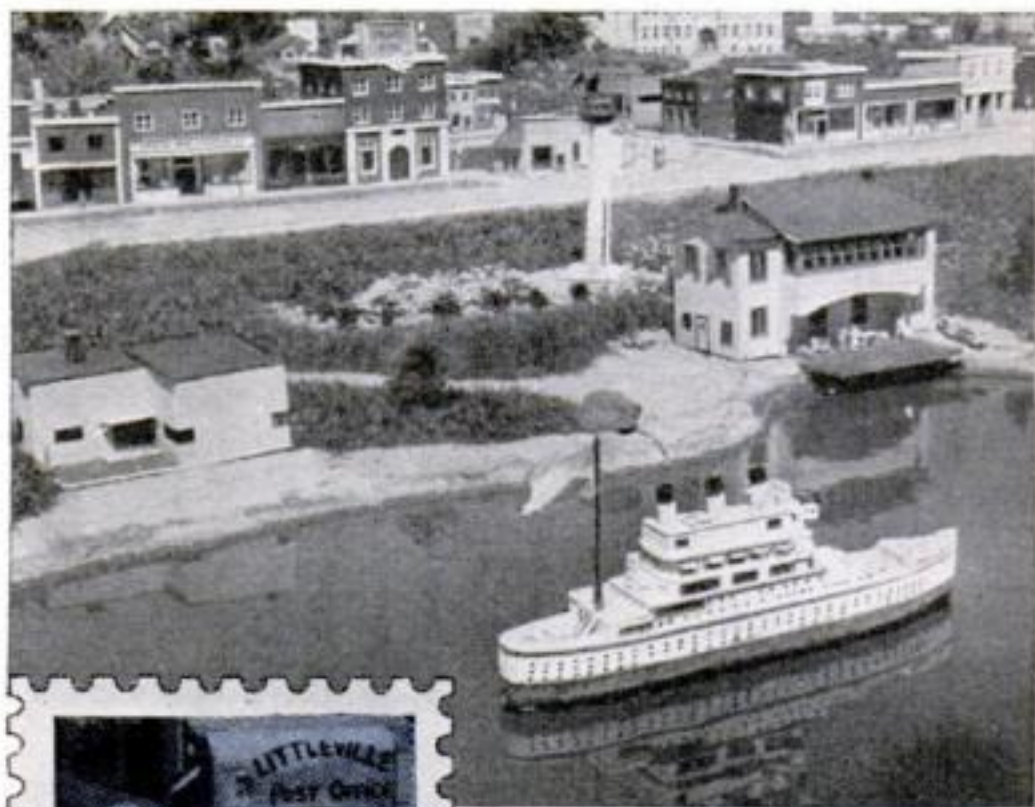
Recently, by means of phonograph records and a loudspeaker system, Murray has added sound effects. Visitors hear chimes and hymns, as they pass by churches, and orchestra and dance music when they near hotels and restaurants. The latest development is an eight-foot-high castle of stone. It weighs more than two tons and stands on a little rise on the outskirts of the city. At present, Murray is spending his spare time working on something he has been planning for a long time. It is a complete steel mill which will be added to the industrial section of Littleville.

Even in so small a city, a problem of sanitation arose, and Littleville has installed a sewage-treatment plant, operated on a non-bacterial principle and said to be odorless. Among the new features which Murray intends to add during the coming year are a drinking fountain and rest rooms.

A lawn mower makes short work of park maintenance



Recorded chimes sound from the church steeples



Off the waterfront, a liner lies at anchor. Visitors mail cards at the post office. Below, Murray builds an eight-foot castle



AUTOS



Big Wheels Rolling

On the following pages, Edwin Teale and Ralph Morse take you for a word-and-picture trip with a trucker

Fast Freights of the Highway Weave a New Transport System

IF ALL the trucks now rolling on American roads zipped past a given point at the rate of one a second, it would take nearly a week for the high-speed caravan to pass. There are more trucks in America than there are miles of highway. Every tenth worker in the country owes his livelihood to some phase of the trucking industry. Virtually all the bread we eat, virtually all the milk we drink, one twentieth of all the nation's freight, as many as 27,000,000 head of livestock and 22,000,000 tons of soft coal roll to market each year on rubber tires. Approximately 40 percent of all the communities in the nation now depend entirely on trucks for their freight service.

"Save a Freight Car for Uncle Sam" was a slogan of the first World War. That slogan gave the roots of the trucking industry, which have since spread so far, their original spurt of growth. Short-haul shippers turned to highway trucking. The machine-gun volley of chugging, backfiring trucks in 1918 helped win the war for

industry as well as for the army at the front. Hostilities ended with approximately 400,000 trucks in action on American streets and roads.

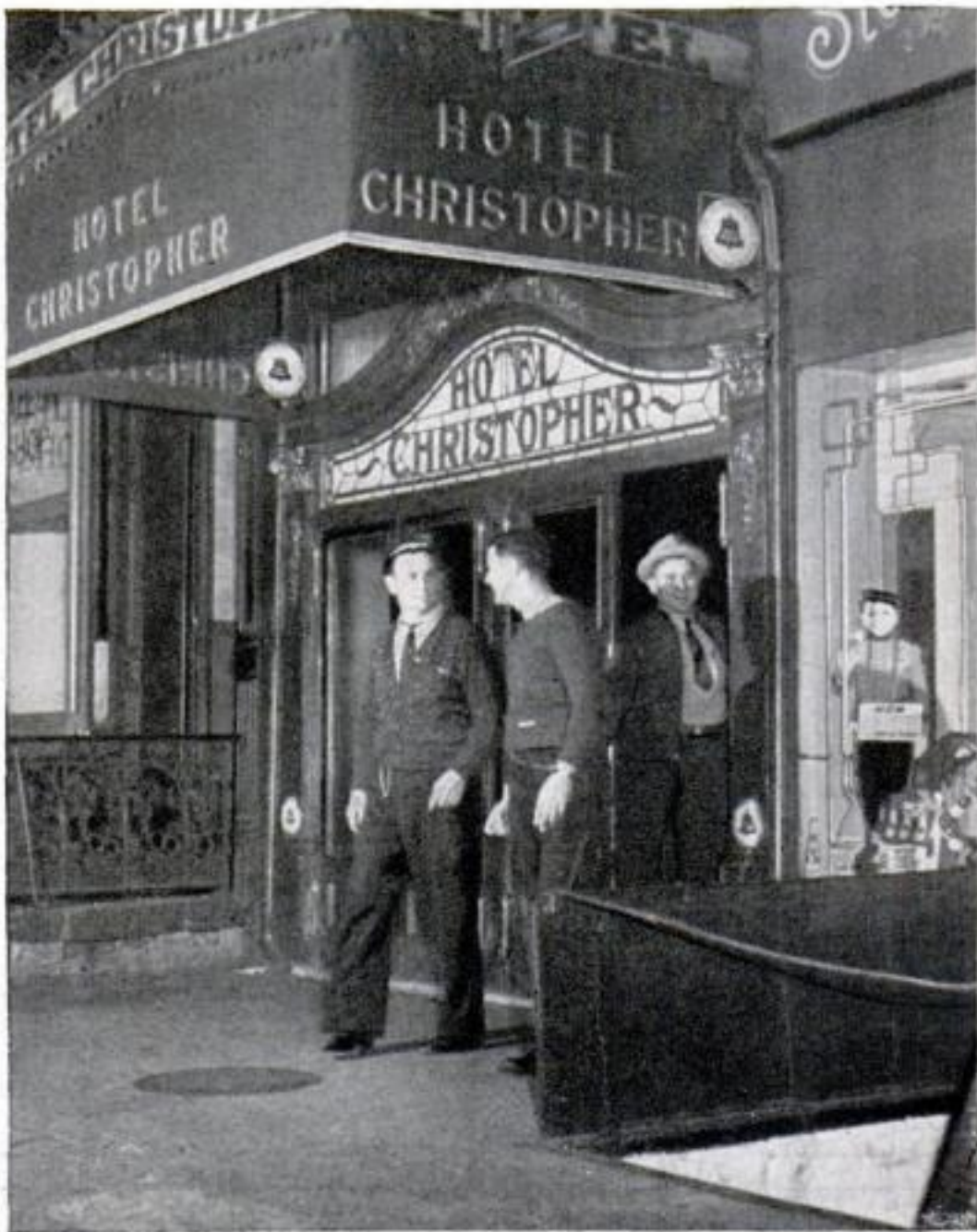
The total has since climbed to ten times that figure. Of the 4,250,000 trucks in operation in the United States, 600,000 are over-the-road machines, fast freights of the highway. In addition, there are the specialty haulers: the long-distance furniture vans, the oil-field trucks, the citrus-growers' fleets, the companies—like Gerosa in New York and Belyeas in Los Angeles—that are equipped to transport anything from a dead whale to a string of abandoned street cars.

As the highway-freight industry gained momentum, little truckers, who began with a single machine bought on time, grew into the owners of high-powered fleets. An era of conflicting routes and cutthroat competition ensued. Finally, in 1935, the United States Government stepped in with the Federal Motor Carriers Act. It placed control of all long-distance trucking in the hands of the Interstate Commerce Commission.

A few weeks ago, this body handed down a decision which trucking men consider a turning point in the history of American highway transportation. It granted permission for 23 Eastern companies to join



Milton Houck, trucker for Horton Motor Lines, plays cards with other drivers in a New York hotel room . . .



. . . until time to pick up his 20-ton truck for the trip to Baltimore. The company rents hotel rooms for its drivers

forces and form the largest over-the-road freight system on earth. Under the banner of this new combine, the Transport Company, 10,000 trucks will shuttle back and forth along the roads of the Atlantic seaboard. Other consolidations are expected to follow.

Backbone of the new Transport Company is the Horton Motor Lines. Its story is typical of the mushroom expansion of the industry. About ten years ago, H. D. Horton, a tire dealer in Charlotte, N. C., found himself with a truck on his hands. The former owner had run up a big tire bill and finally had turned over his machine in payment. Thus, much like a small boy who learns to swim by being thrown overboard, Horton got into intercity trucking. As years passed, he added machine after machine until, by 1939, 600 shining, stainless-steel tractor-trailer units, each bearing the name of Horton in big red letters, were bringing in a total revenue of around \$4,500,000 a year. Extra-fare, extra-fast service between New York and southern cities has been a feature of Horton operations.

The two other members of the "Big Three" in long-distance freight trucking are the Keeshin Motor Express Company, with headquarters in Chicago, Ill., and the Freightways system of the Northwest. John

L. Keeshin, President of the Chicago company, began business with a two-cylinder, chain-drive truck that bumped along—when the chains didn't break—on hard-rubber tires. Now he directs more than 1,400 canary-yellow units that speed along the highways of 18 states and carry more than 18,000,000 pounds of freight a year. The Keeshin trucks roll away from the Chicago terminal on runs that carry them as far east as New York and as far west as Iowa.

The longest runs of all are logged by the Freightways drivers. Formed of eight companies working in coöperation, this organization, with headquarters in Portland, Ore., hauls freight as far north as Edmonton, Canada; as far south as Los Angeles, Calif.; and as far east as Minneapolis, Minn. At present, this western organization is experimenting with refrigerated trailers in which chemicals circulate through coils to cool the interior.

A sidelight on the expansion of trucking is found in figures for a recent year. During the 12 months, new trucks were added to the highway-freight service at the rate of nearly 200 a day, or 1,400 a week. Traveling more than 15,000,000 miles a year, the over-the-road fleet has become an indispensable part of our transportation system. Rain or shine, trucks are delivering the goods.



At the terminal, he gets his bills of lading in a locked, waterproof bag. Drivers never know what's in the trucks



As many as 24 trips leave between 6 and 10 p.m. The dispatcher's board lists trucks loading. (Continued)



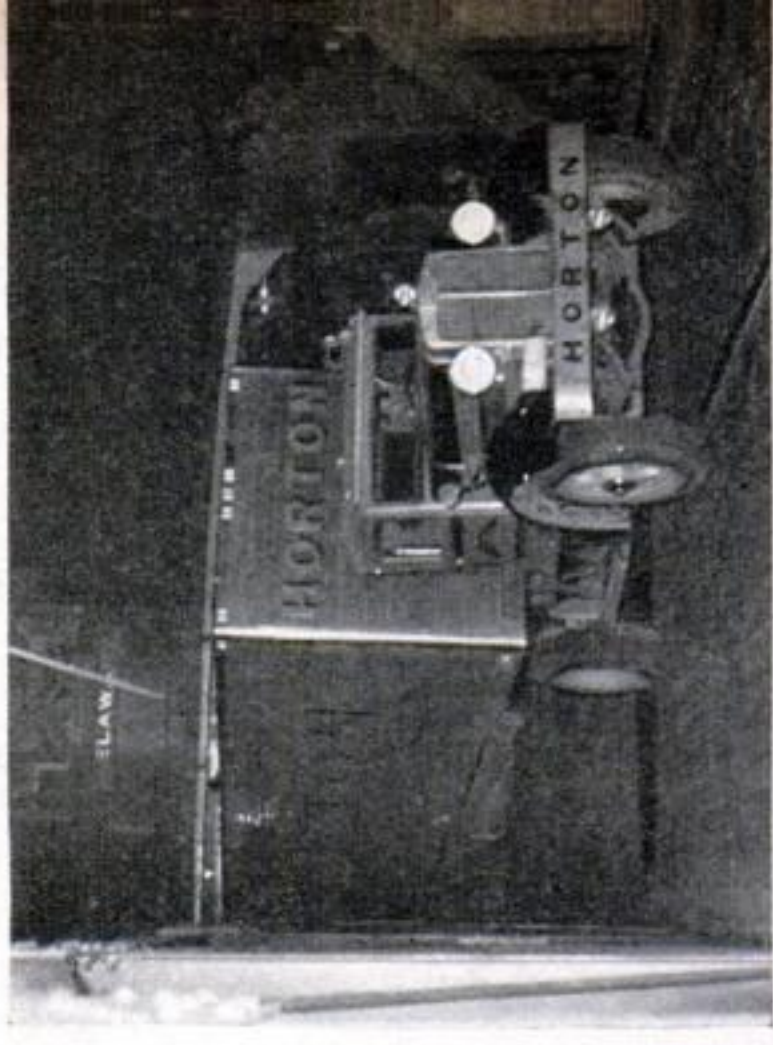
Houck drives the same tractor unit on all trips. Here a mechanic is giving it a check-up while the light, stainless-steel trailer is loaded. It holds 1,620 cubic feet of freight



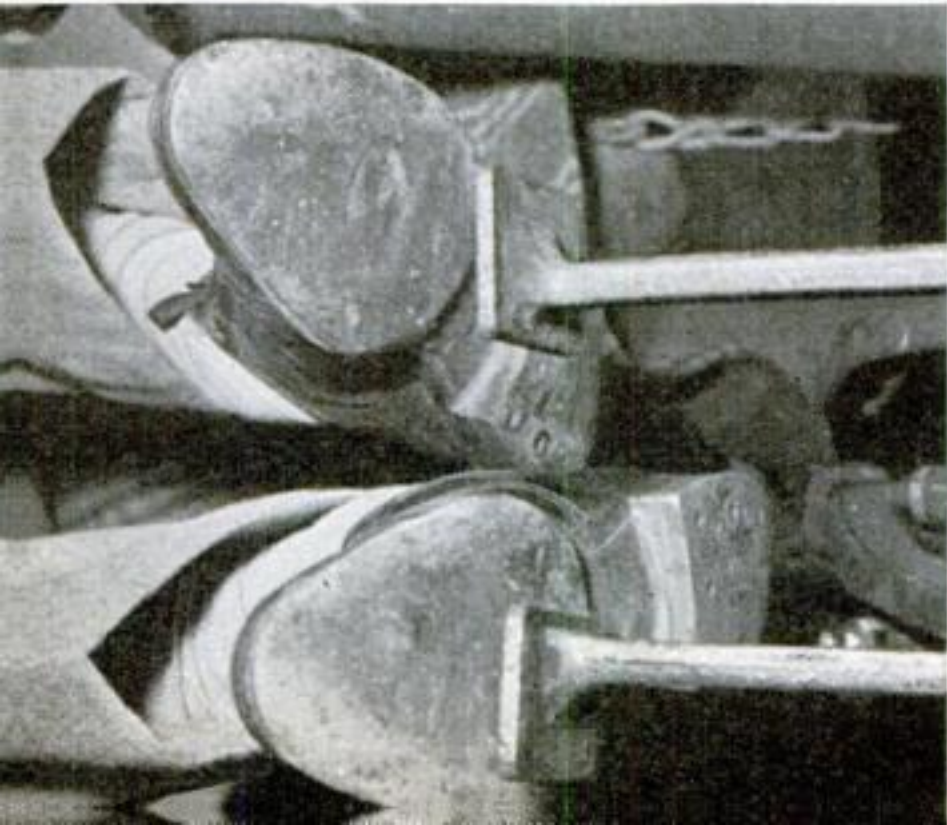
Houck checks his air-brake connections as required by law



and lets in the clutch to start the 8-hour, 200-mile trip.



Hours later, he rolls off the Delaware ferry in Chester, Pa.



His left shoe wears out faster than his right



When trucks meet on the road, the drivers exchange useful information by hand signals. This one gives warning that police ahead are "weighing in" all trucks to see whether they conform to the law



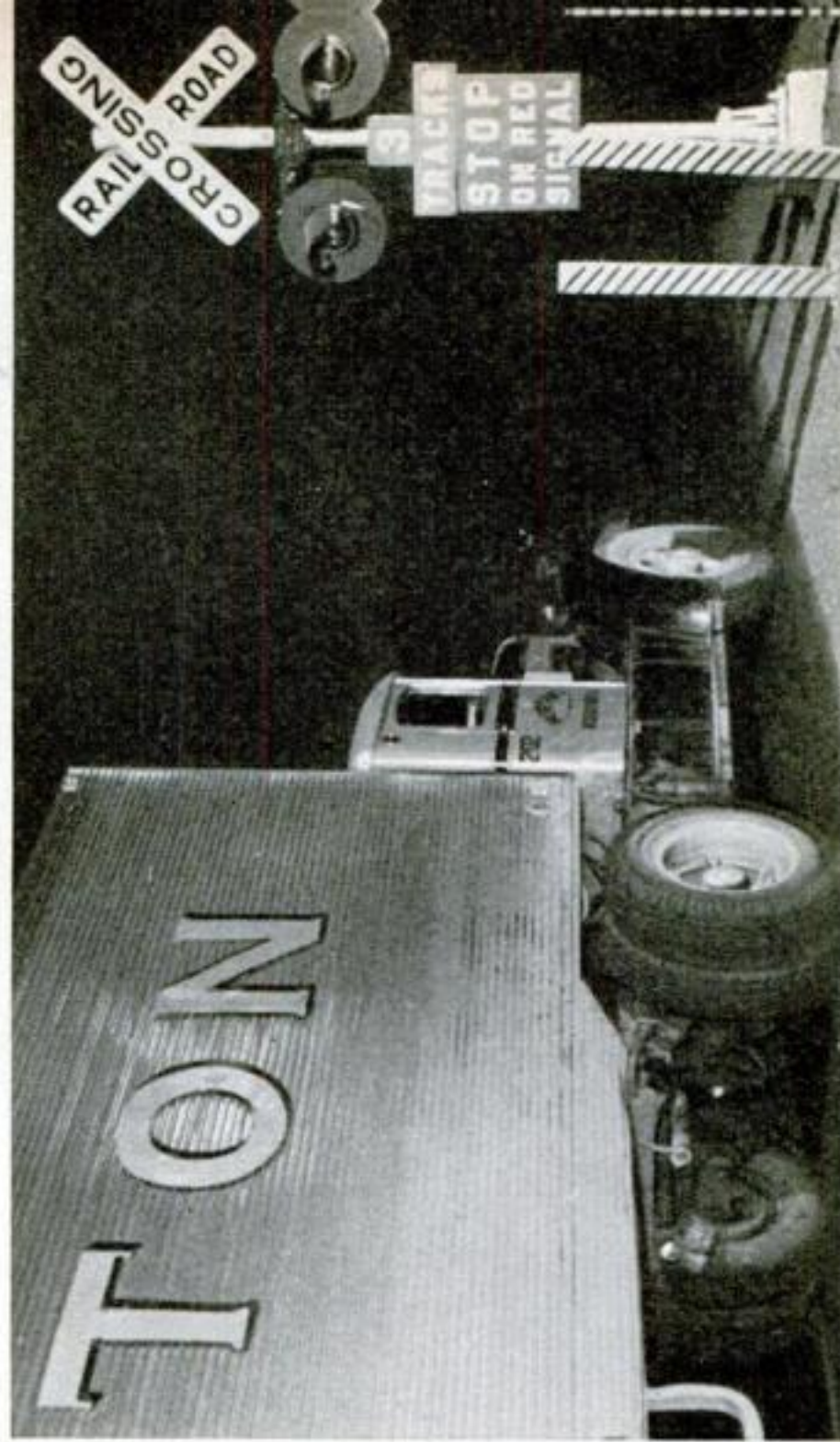
... and this one means, "There's a motor-cycle cop hidden down the road. Watch out!" Truck drivers are a clanish lot, and often travel in caravans so they can help one another in trouble



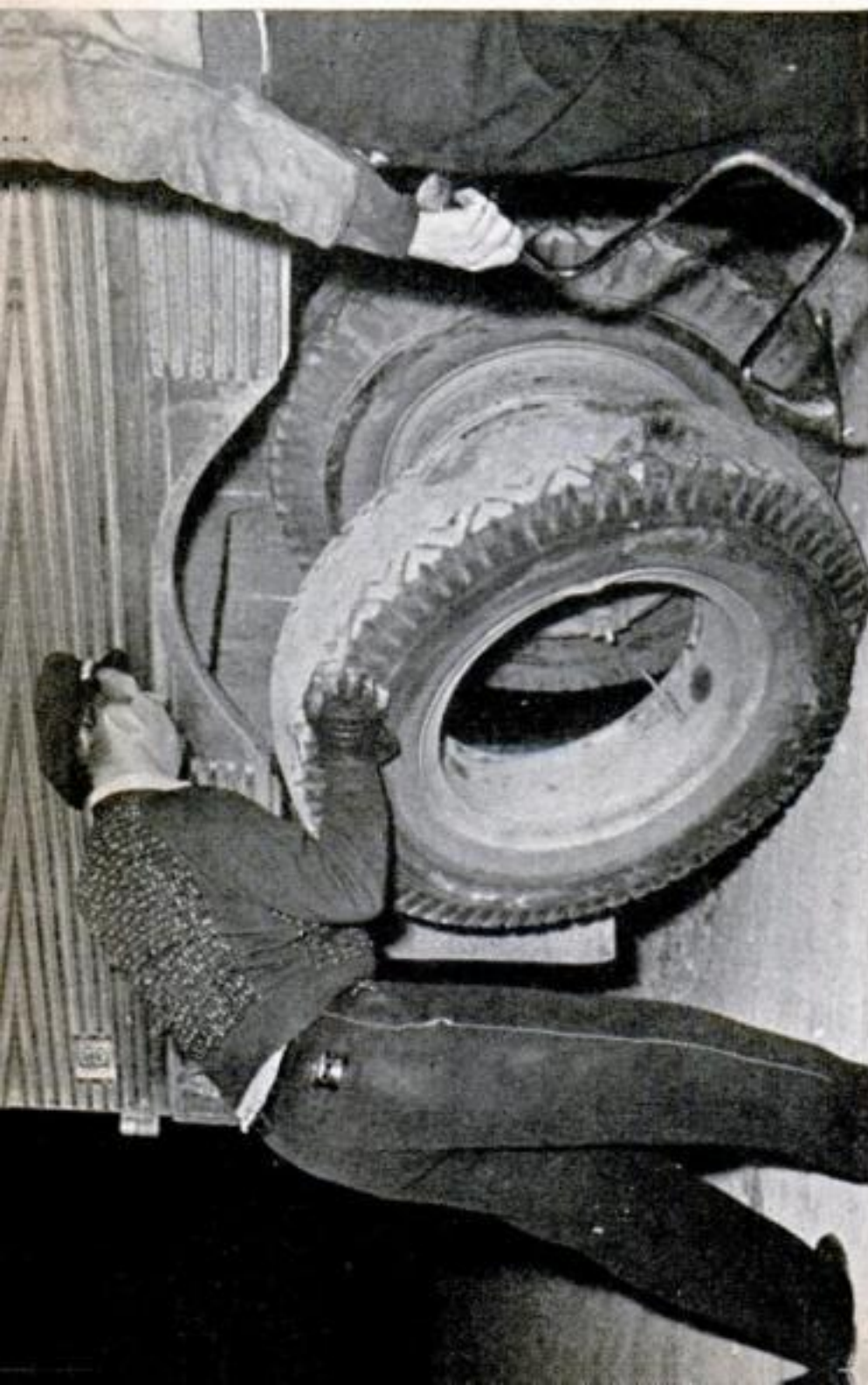
At a stop for fuel, Houck checks up on his motor



On through the night roars the highway freighter. Trucks must stick to certain roads



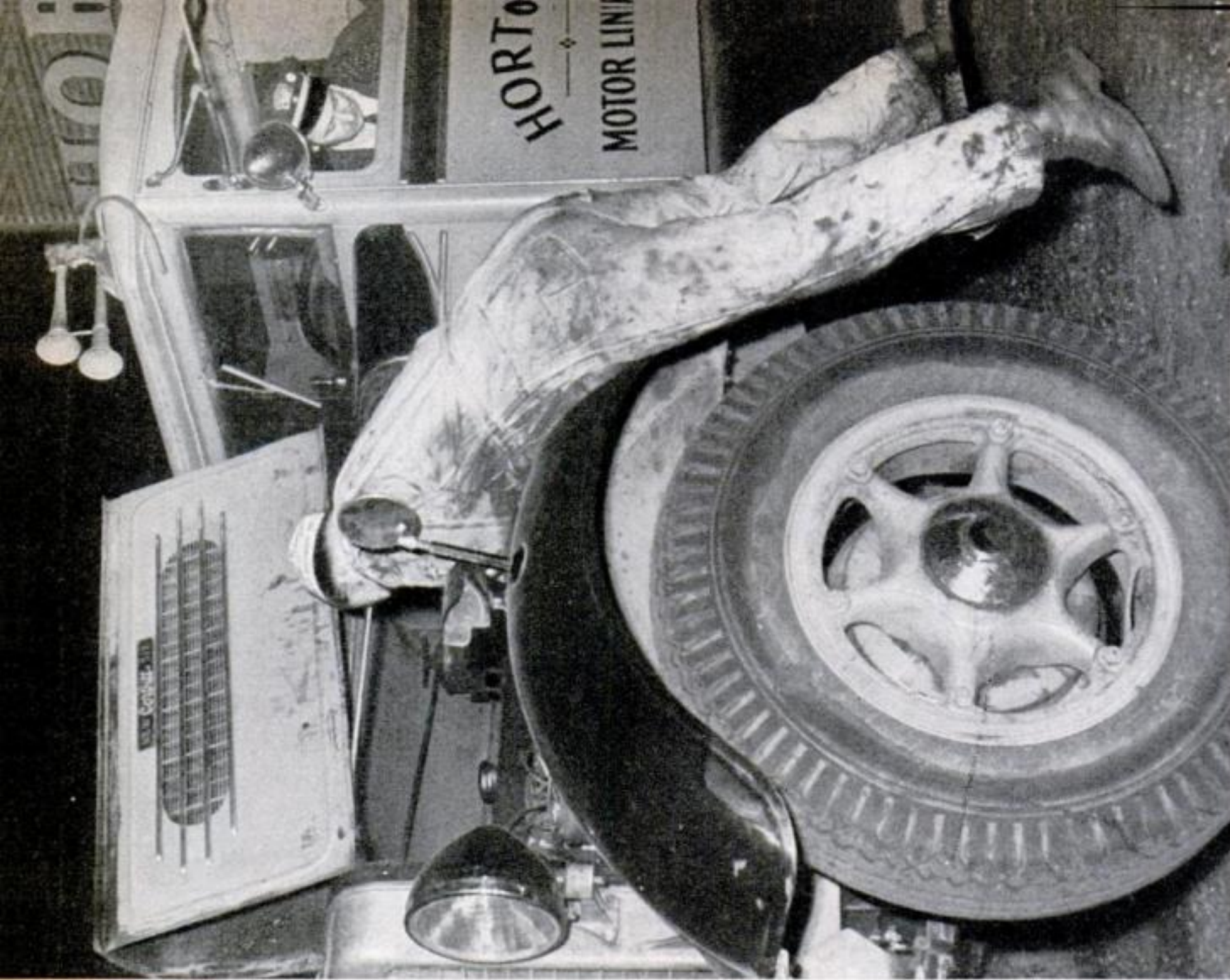
... and, like busses, they are required to stop at all railway crossings (Continued)



Changing a 150-pound tire takes only five minutes. Average tire mileage is 60,000 miles



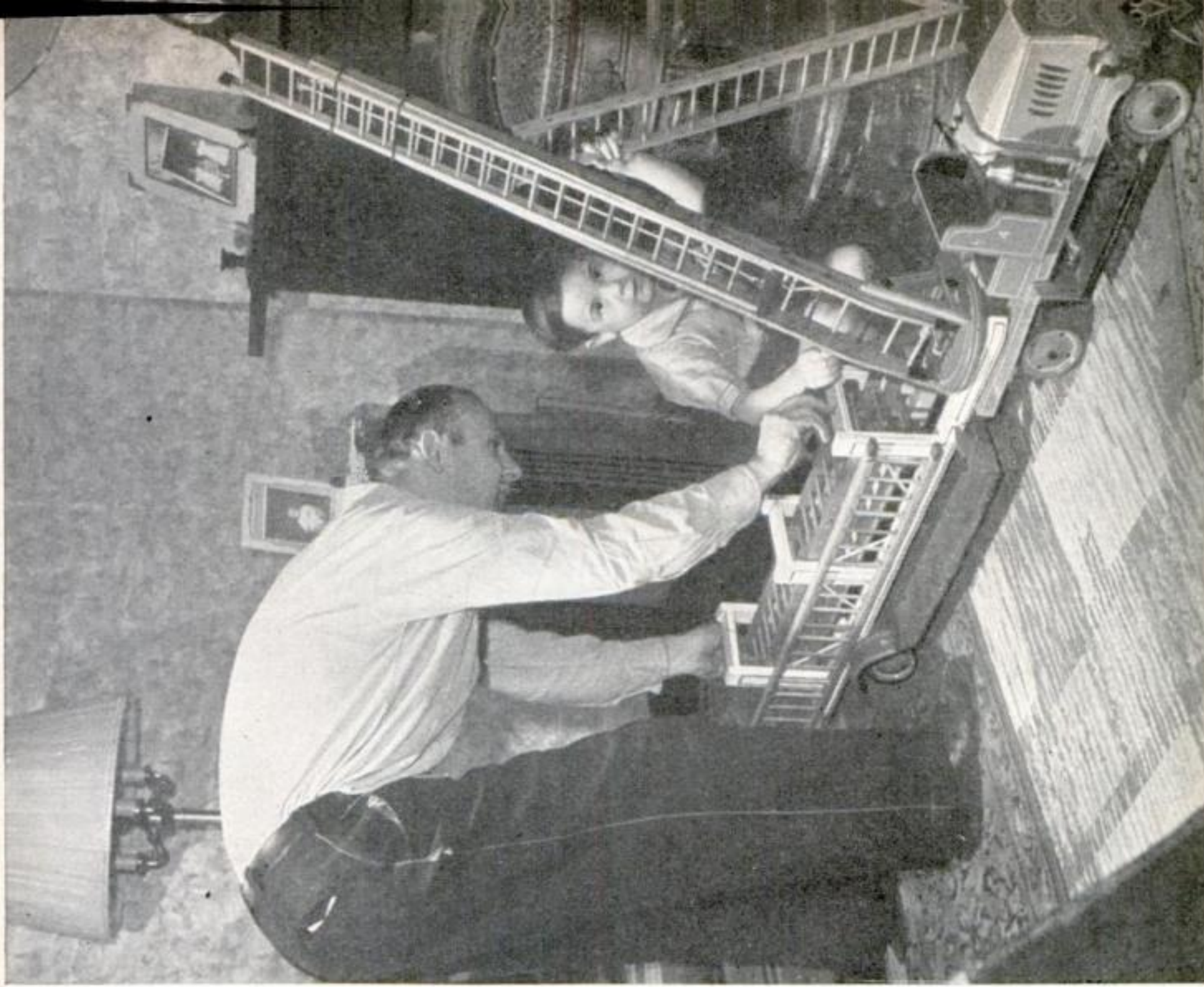
At supper in a roadside stand, Houck writes his log. He must record every stop until . . .



. . . he reaches the Baltimore terminal and turns his truck over to the handlers



Then he draws his pay. Houck gets \$41.50 a week for three round trips—1,200 miles



At home in Baltimore, he enjoys a busman's holiday playing with his son's toy fire truck

Streamlined Gasoline Promises **More Miles a Gallon**

By **SCHUYLER VAN DUYN**

IF YOU think the 1941 cars are tops in performance, there's antiknock gasoline in the offing that will make you hunt for new superlatives to describe your 1946 model. From all present indications, it will drive the 1946 cars faster and with more power and pick-up than present gasoline drives present cars. But most important of all, it will drive them many more miles to the gallon!

Engineers in both the gasoline and automobile industries have made this clear recently. Some even say that today's cars have more than adequate speed and power—at least for present highways. For the next few years, emphasis will be on maintaining this performance while boosting mileage.

Earl Bartholomew, director of the engineering research laboratories of the Ethyl

Gasoline Corporation, predicts that in five years a high-power gasoline will be available at roadside service stations that may improve car economy by 35 percent, "with performance even better than it is today." Similarly, T. A. Boyd, of the General Motors Research Laboratories, prophesies that the next major change in automobiles will be a doubling of the miles driven on a gallon.

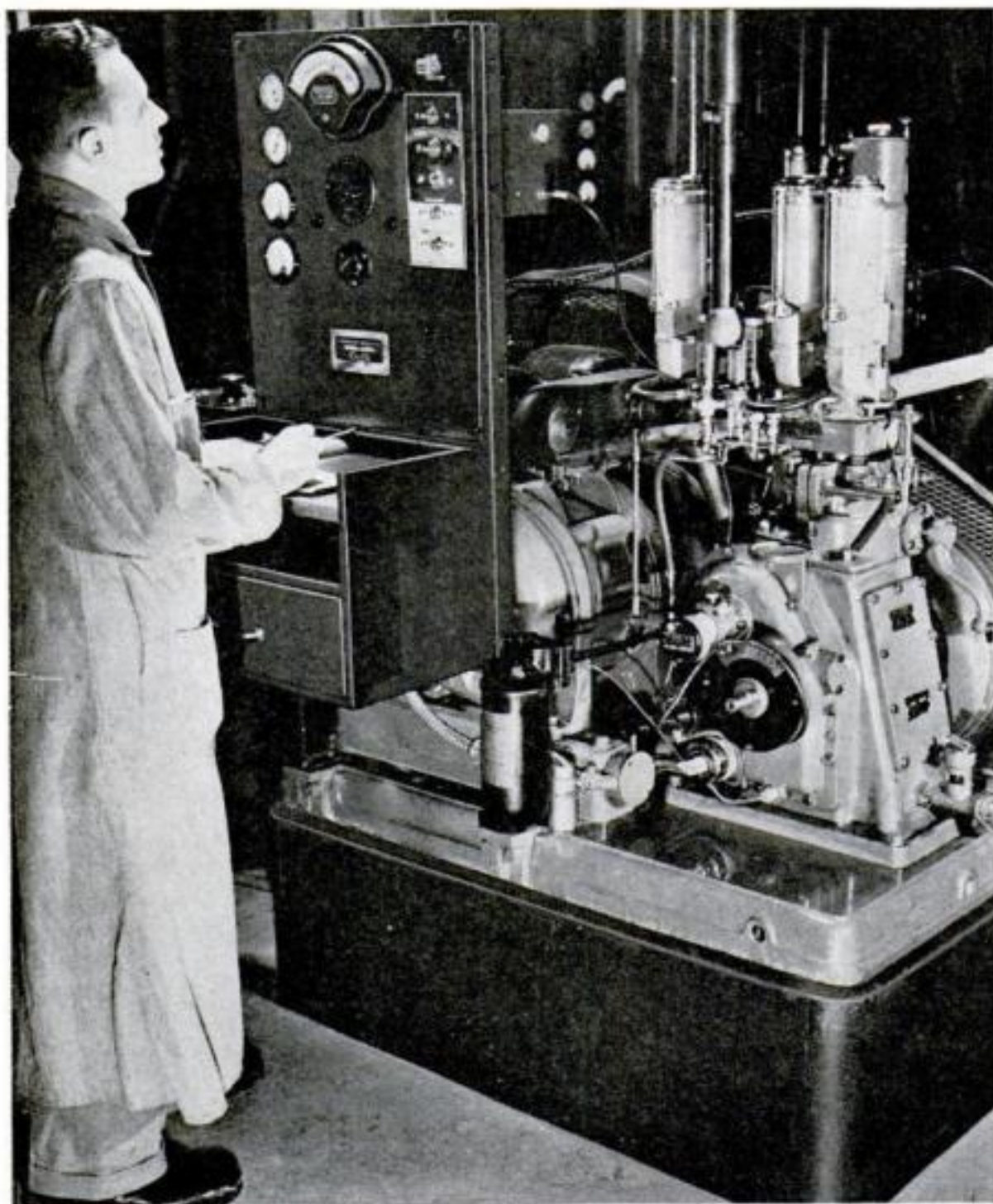
Why the change? Could it have come sooner? Will it really come?

Answers to these questions are found in many laboratories. It was in one, that of General Motors, that the story of better fuels for better engines began. There, soon after the first World War, an engineer already famous for his invention of the self-starter first gave serious attention to the growing problem of engine knock. Knock is recognized today to be caused by an almost instantaneous explosion which inter-

rupts the normal burning of the fuel charge. It occurs when the critical knock point of the gasoline is less than the temperature and pressure rise generated during the burning of a fuel. Little was known about it then, however, and there were even some who blamed the engineer, Charles F. Kettering, for it. Before cars had self-starters, it was said, they did not knock.

"Boss" Kettering had other ideas. He had observed that the famous Liberty motor knocked less on gasoline made from the crude oil of certain wells, and it was then being recognized that the more an engine's fuel charge was compressed, the more it knocked.

So Kettering assigned Thomas Midgley, Jr., and T. A. Boyd to dig into the knock problem. Before they finished, they knew that knock came from gasoline, and had discovered something to add to the gasoline to stop knock and allow higher compression.



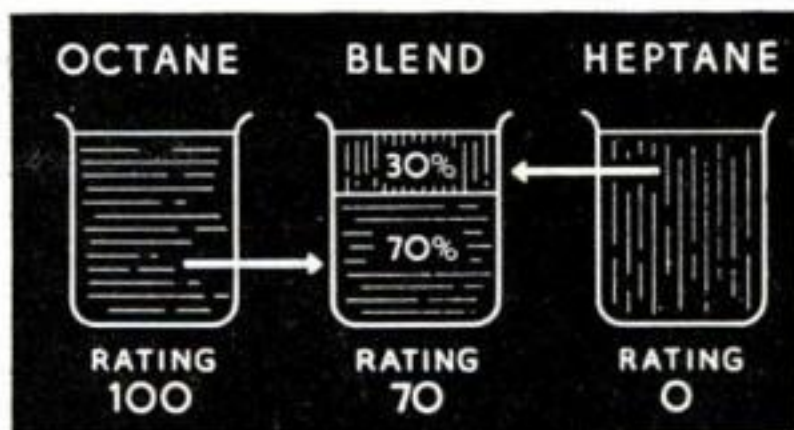
The latest "guinea-pig" engine for testing antiknock quality of fuel

A one-cylinder gasoline engine became the guinea pig for their tests. On its top, they built what they called a "bouncing pin." Through a hole in the head of the engine, exploding fuel compressed a diaphragm when knocking skyrocketed interior cylinder pressure. The diaphragm bounced a metal pin against contacts to close an electric circuit and deflect a needle on a dial. The worse the knock, the greater the needle deflection.

For their tests, they combed the wares of chemical supply houses for odd substances, and they searched through volumes of reference books. The possibilities of 33,000 compounds were explored before they found one to do what they wanted it to. It was tetraethyl lead.

Added to gasoline in small quantities, it reduced knock. But, unfortunately, it deposited metallic lead on vital parts of the motor. Adding other compounds, ethylene dibromide and ethylene dichloride, stopped this. But the bromine of the dibromide was not plentiful—except in the ocean, each million parts of which contain 67 parts of the element. No one had yet succeeded in

WHAT DOES OCTANE MEAN?

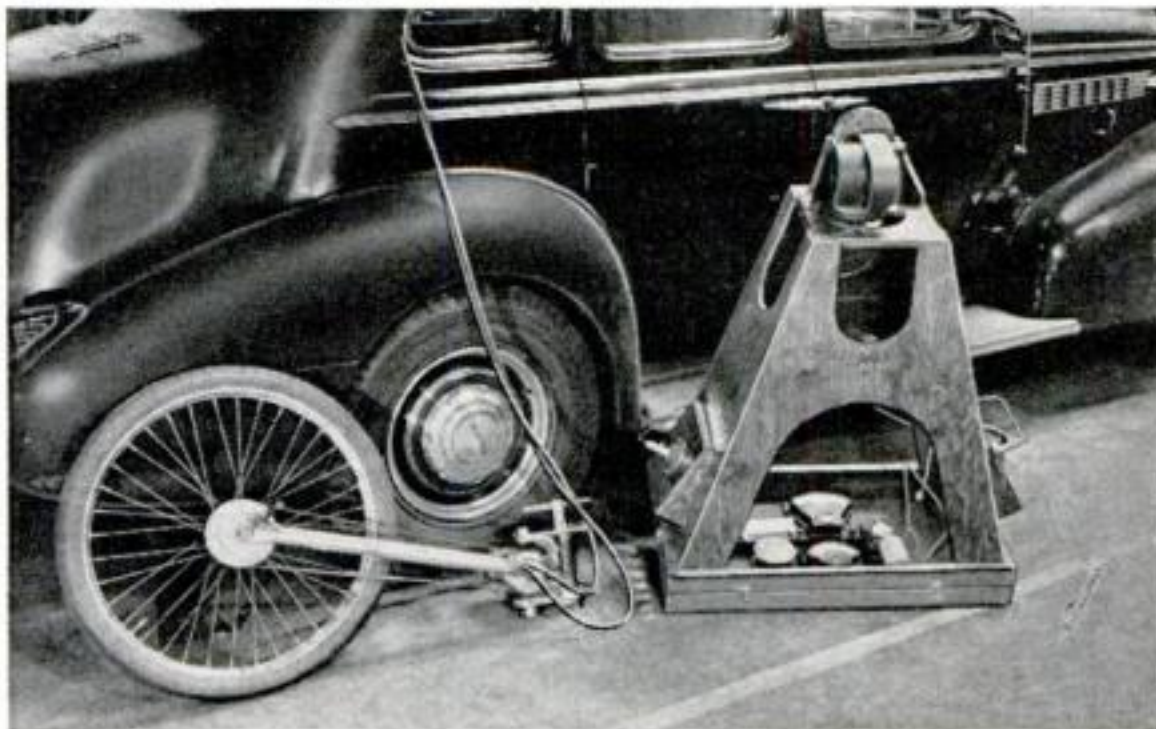


"Octane number," the yardstick for measuring antiknock quality in gasoline, is an arbitrary scale based on the expensive hydrocarbon fuel octane, rated at 100, and knock-producing heptane, rated at zero. Mixtures of these provide the standards for tests

extracting it commercially from sea water.

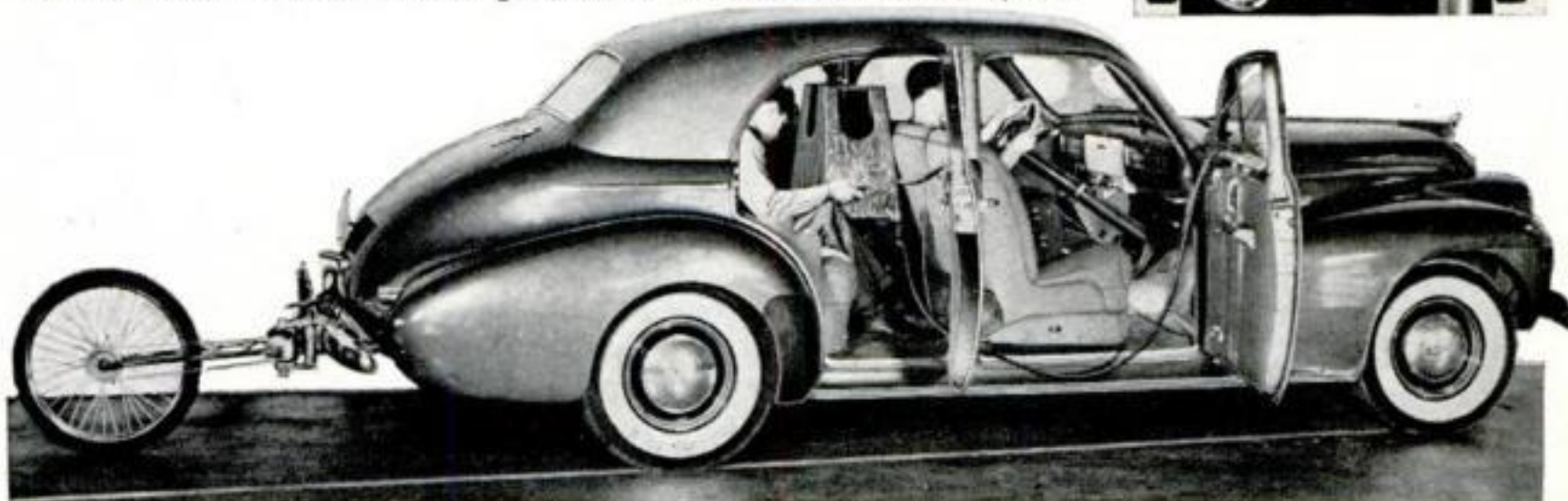
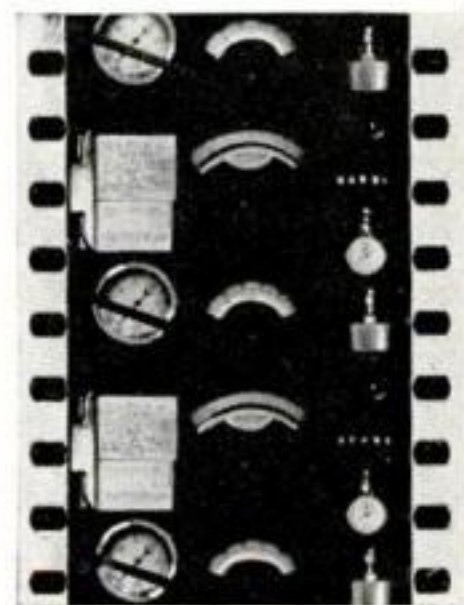
Using what they had, the General Motors Chemical Company began producing the perfected antiknock compound. In February 1923 it first went on sale at a Dayton, Ohio, filling station where contraptions fastened

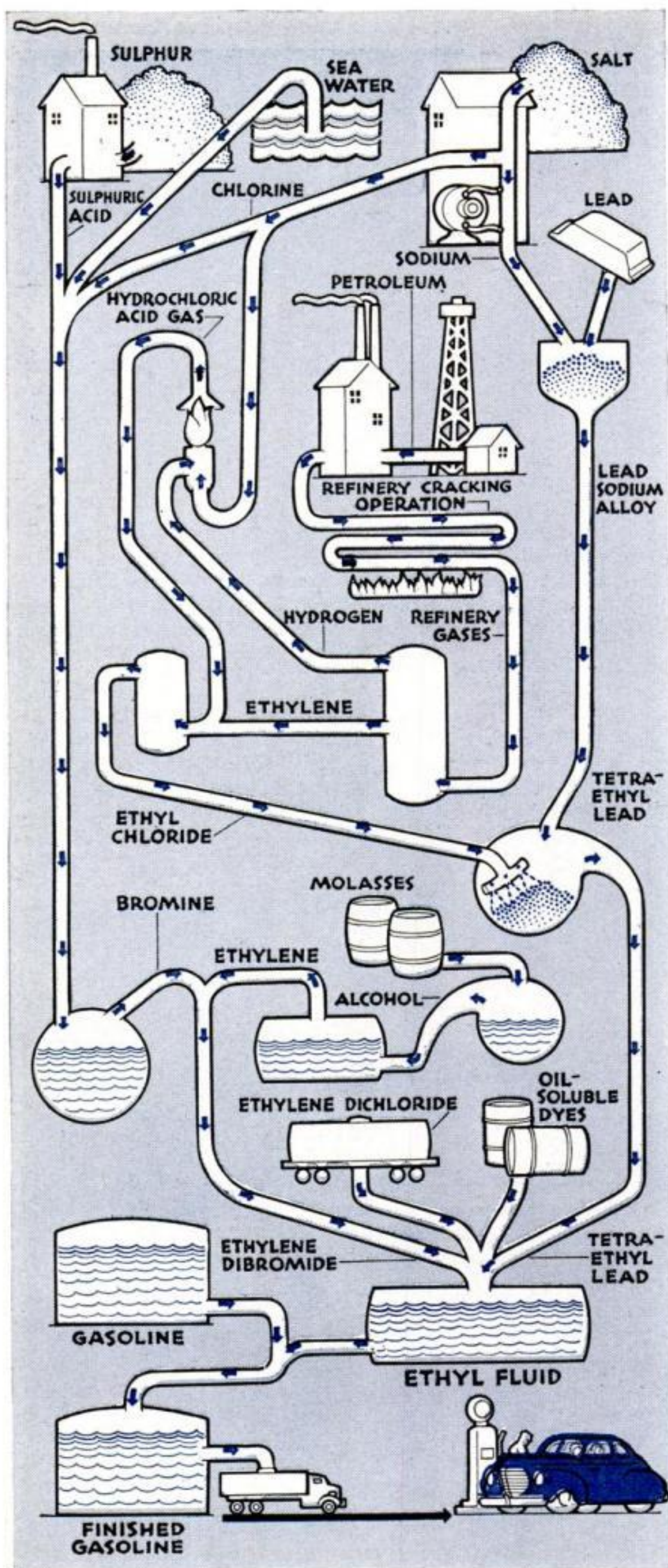
ROAD TESTS CHECK MOTORS AND FUELS



The fifth wheel towed behind gives accurate measurement of speed

For tests on the road, the apparatus at the left takes movies to record readings on a panel of instruments



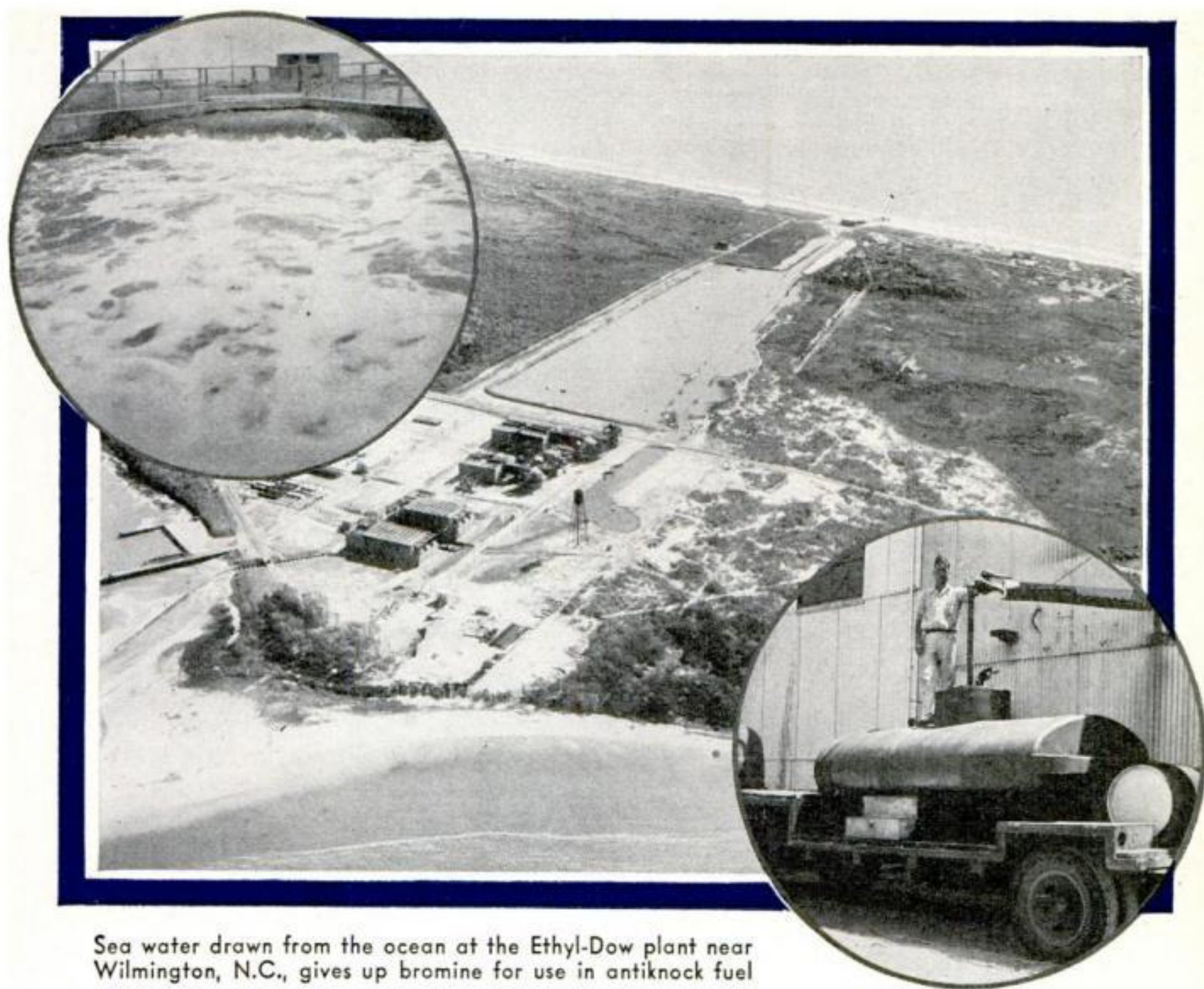


to the gas pumps injected the fluid drop by drop into gasoline as it flowed into car gas tanks. In 1924, Standard Oil of New Jersey joined forces with General Motors and the Ethyl Corporation was formed. A year later, a system of adding the antiknock liquid to gasoline at the refineries was devised, and leaded gasoline scientifically blended for utmost efficiency went on sale.

That was for cars with compression ratios of four to one. This means that if a cylinder held two pints with its piston down, the two pints were compressed into half a pint when the piston reached the top of its stroke. Endless gasoline-refining improvements began to pace engine improvements. And always the best of the gasolines could be still further improved in antiknock quality by adding tetraethyl lead.

By 1930 so much was being used that the supply of bromine threatened to become inadequate. Anticipating this shortage a few years before, a freighter, the *S. S. Ethyl*, had been fitted out and sent to sea to test the possibilities of taking bromine from sea water. From the lessons learned on this boat, plus several years of research following its cruise, the Ethyl-Dow Chemical Company, jointly owned by Ethyl and the Dow Chemical Company, erected on the sand dunes at Kure's Beach, near Wilmington, N. C., the world's first commercial sea-water mining plant.

Pumping millions of gallons daily from the ocean, the plant treats them with chemicals in huge "washers" that scrub pure bromine free from its salt-water imprisonment. From the bromine and grain alcohol, Ethyl-Dow then makes the ethylene dibromate that is so vital to the use of tetra-



Sea water drawn from the ocean at the Ethyl-Dow plant near Wilmington, N.C., gives up bromine for use in antiknock fuel

ethyl lead as a knock suppresser. Other chemicals enter complicated reactions to produce the complete antiknock compound: sodium, chlorine, acids, lead, to name a few, along with generous quantities of what, when mixed, form a famous old remedy—sulphur and molasses.

Although the unique plant has been operating more than eight years and today produces over 3,000,000 pounds of bromine a month, it has not yet pumped up and discharged a single cubic mile of sea water.

During these years, car makers were solving problems, too. New carburetors and manifolds were designed to speed charging the cylinders with fuel. Crankshafts were counterbalanced to lessen vibration. New metals went into valves, pistons, and cylinder heads to lengthen engine life and provide the added strength needed for the more powerful engines. New ceramics improved spark plugs, and overall engine weight dropped.

Ethyl engineers showed that compression-ratio increases were actually reducing the strain on connecting-rod bearings and

other parts as higher turning speeds exerted greater centrifugal forces to overcome the effects of more powerful cylinder explosions. They showed that so much more of the increased heat that the improved engines were generating was actually being converted into extra power that the interior engine temperatures and heat wasted to cooling water were even lower than in old-style engines.

Knock-measuring methods had come a long way since Midgley's and Boyd's guinea-pig-engine days, but no single standard had been set. So Ethyl's Graham Edgar devised the "octane number system." A readily available fuel of minimum knock tendency, known as iso-octane, and another of maximum knock tendency, normal heptane, were assigned standard values of 100 and zero, respectively.

Now if 70 parts of iso-octane were mixed with 30 parts of normal heptane, a fair antiknock fuel was the product, and any gasoline that knocked exactly as much under standard test conditions was called 70-octane gasoline. *(Continued on page 235)*

Trial by Mud

ARMY FRAME-BUSTERS TORTURE FIGHTING TRUCKS IN A VERSATILE HOG WALLOW

THEY call them "frame-breakers" in the Army.

It's a tough name for men with a tough job—the job of smashing shiny new trucks just to learn what makes them fall apart; just to make sure that that particular failure won't occur again when lives may hang in the balance.

They're specialists, these men, for they

put these mechanized mules through tortures so rigorous that it seems they could have been thought up only by men who hated trucks.

They send a six-tonner hurtling over a concrete "washboard" so fast that at times all six wheels are a foot in the air.

They plunge big trucks and little trucks into sticky mud four feet deep, and punish

the tires against forgotten pieces of broken springs and axles that lie at the bottom.

They force them from a standing start to climb a 65-percent grade.

Yes, these "frame-breakers" live up to their name, whether they're bouncing their steeds off sharp hillocks or purposely getting trucks stuck in quicksand and mud—that to the end of making the trucks pull themselves out by winches and steel cables.

The torture ground is down at Camp Holabird Quartermaster Depot at Baltimore, Md., and Army engineers modestly admit that it's the meanest proving area in the world.

The rules for the men bear them out, as revealed by Capt. Eugene L. Moseley, the test officer, who can bruise a truck with the best of them. He limits the "cowboys," as some of them prefer to be known, to one hour of driving in six hours of duty when they are working on the more violent tests. He sees that they are supplied with kidney belts to brace their insides against the bumps, although they do say that some of the sturdier "frame-break-



A 1 1/2-ton Chevrolet truck hits a bad spot in the Camp Holabird mud hole



Weighted trailers replace loads that the trucks will tow in service



Capt. E. L. Moseley (left) and three of his truck-busters. Left to right: Sergeant Leonard Littlefield, Privates Leon Rewt and Andrew Jaquay

ers" refuse to be bothered wearing them.

What do they test? They're ready to torture any car that a manufacturer wishes to submit, if it meets their specifications, even though there is no contract for that make. If it passes the slam-bang ordeal with flying fenders, they jot that down as an additional source of supply for an emergency. In recent weeks they've done their truck-busting on everything from a quarter-ton Bantam reconnaissance car to a thirteen-ton Diesel-powered Oshkosh.

At that time the depot had 45,321 trucks on order. The biggest bunch was 20,334 Dodge half-ton jobs for hauling 37-mm. guns, which themselves weigh almost half a ton. There were also 101 Corbett six-tonners for hauling the eight-ton, three-inch anti-aircraft guns, 1,000 six-ton Diamond T's, 10,628 Chevrolet 1½-tonners, and 13,187 G.M.C. 2½-tonners.

In their search for equipment that will stand up under any kind of treatment it might get in service, the test engineers usually take the first unit off the production line. Further production is held up while the

"pilot-model" is given a thirty-day workout.

The pilot model goes first to the shops at the Holabird depot for technical and engineering inspection. Then it goes on the road for 5,000 miles under varying combinations



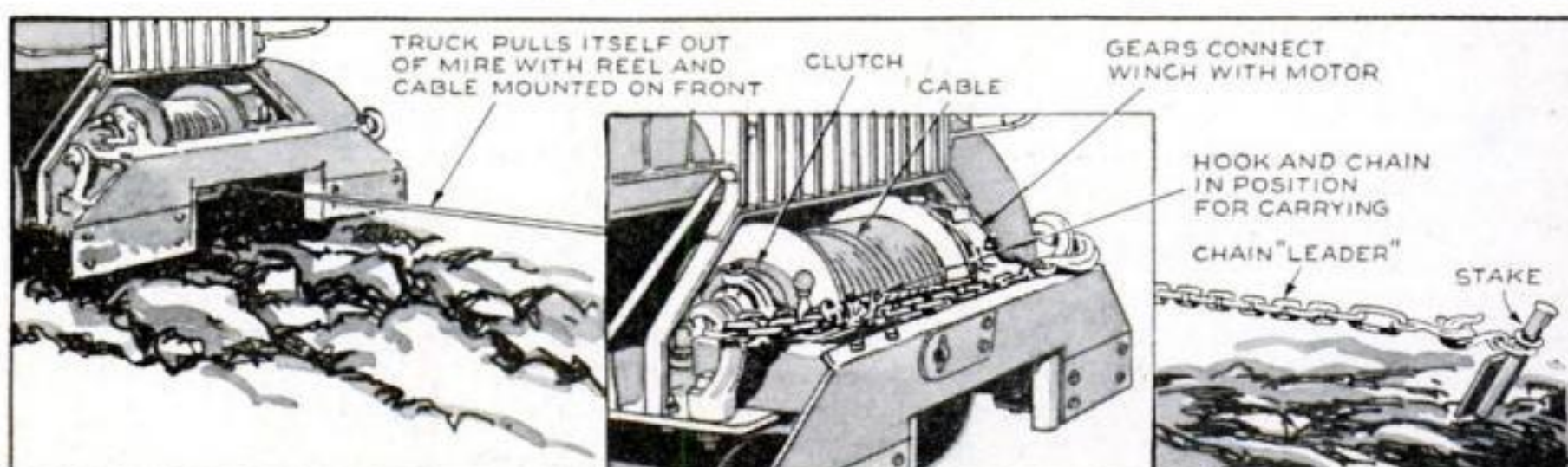
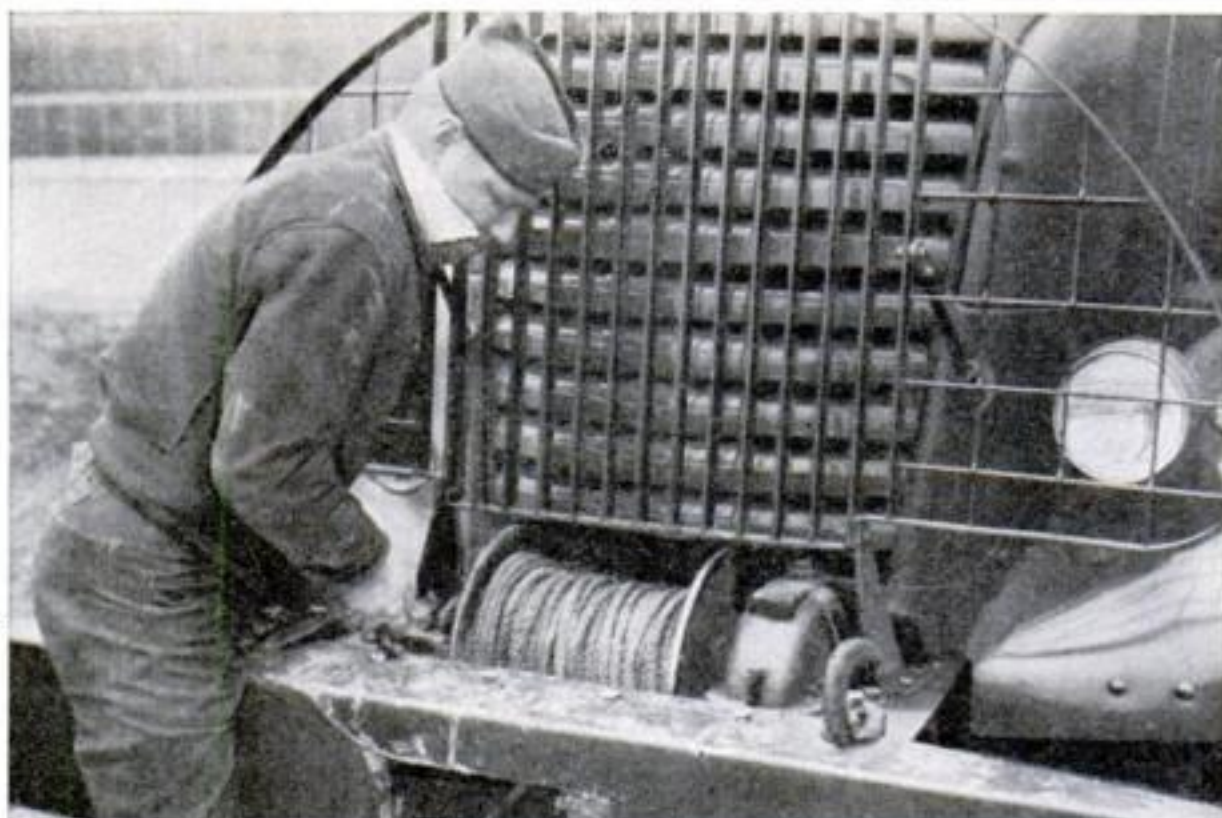
Private John Brandenberger inspects a tire chain



Two trucks with trailers, hub-deep in the vast hog wallow. Men are attaching cables to pull them out

Many army trucks are equipped with built-in winches so they can lift themselves out of mud by their bootstraps

With a steel cable and chain leader run to a four-foot steel stake driven in the ground, the truck's engine turns a drum to pull the monster out gradually onto firmer footing



of loads and speeds, tackling everything from rutted country roads to main-line highways. Most trucks are required to maintain 45 miles an hour on level roads and to climb a five-percent grade in high gear with a full load. If any part is suspected during this initial trial, the machine is torn down to the last cotter pin and inspected again.

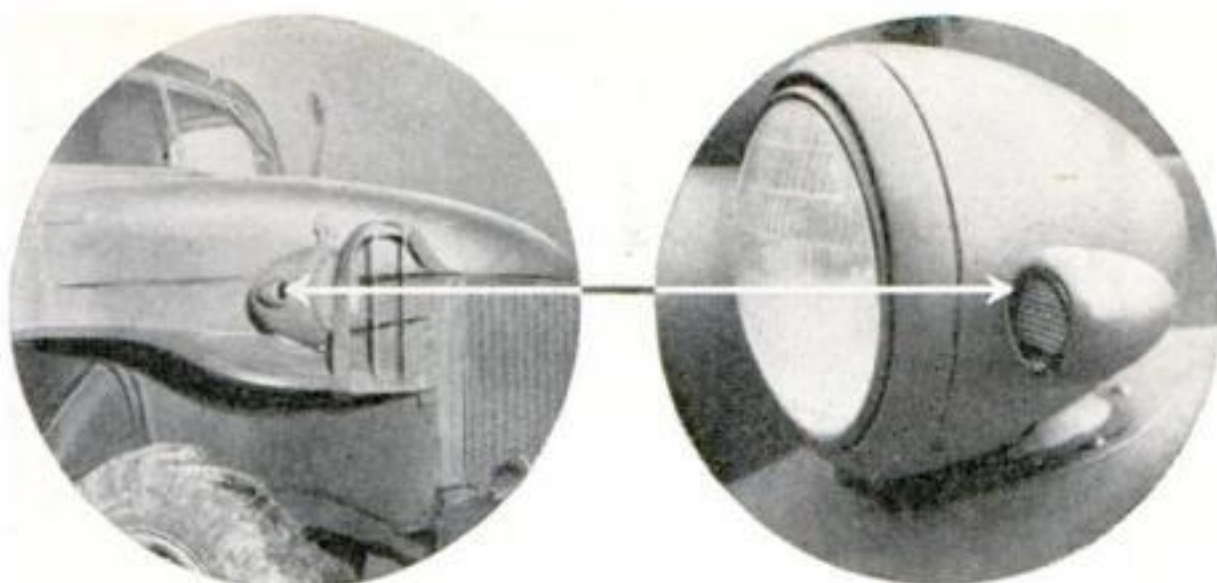
Then comes trouble in a big way. First there's a 1,000-mile jaunt on what is laughingly called a "cross-country" course. There's a buckety-buck ride over foot-high

concrete blocks, so spaced that one wheel is on the blocks while the opposite one is on the ground. There's that climb up a 65-percent grade that would leave a modern passenger car with its rear wheels spinning helplessly.

The course includes chuckholes, and hill-ocks so sharp that their tops scrape the undersides of the truck frames while the wheels drop off on each side. And it has roads so rough that, according to camp rumors, W. P. A. workers have to be kept



Truck-busters enjoy thinking up tests like this . . . and this (to see whether wheels will hit fenders)

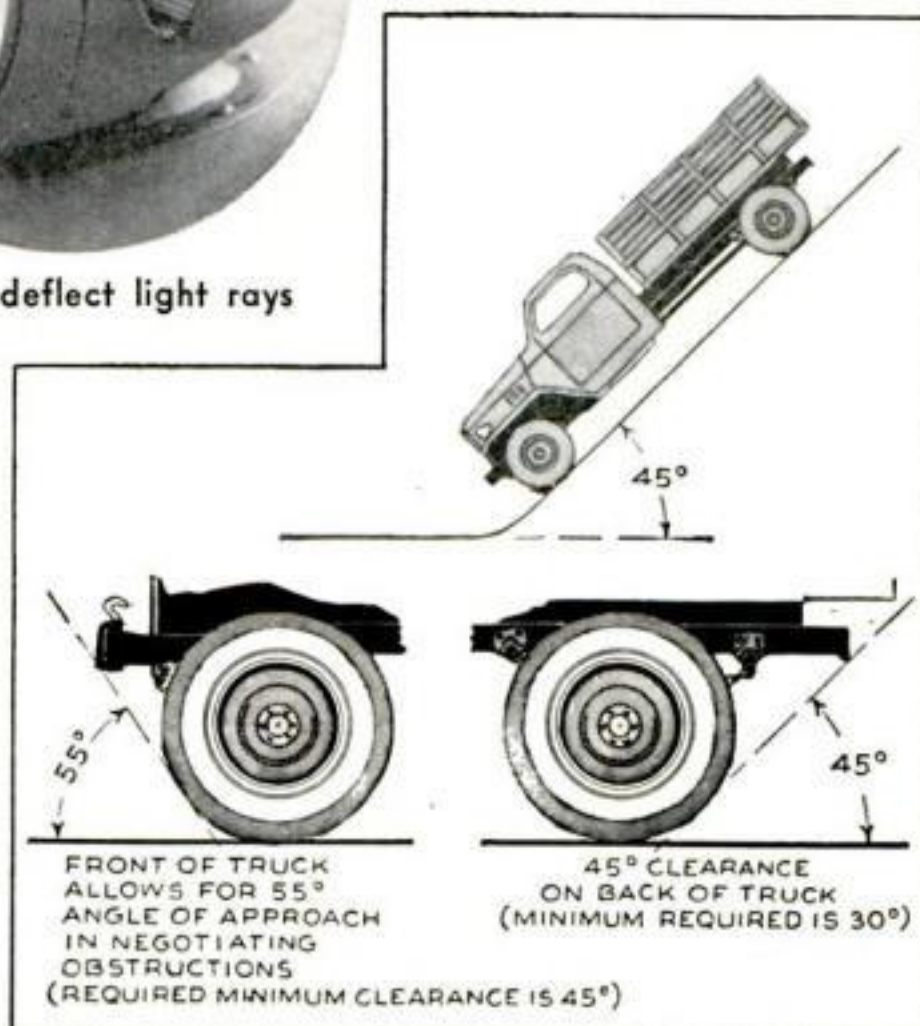


Auxiliary black-out headlamps have shutters to deflect light rays

Overhang of front bumpers and rear ends is carefully checked so trucks won't snag themselves. Climbing a 65-percent grade is one of the little things a U. S. Army truck must be able to do



A concrete "washboard" tortures the machines



from improving them in their spare time.

Rough, did we say? Why, in one recent test on a six-by-six, as the engineers call a six-wheel truck with a six-wheel drive, two axles were broken and replaced and fifteen tires were flattened and repaired—all within forty-eight hours!

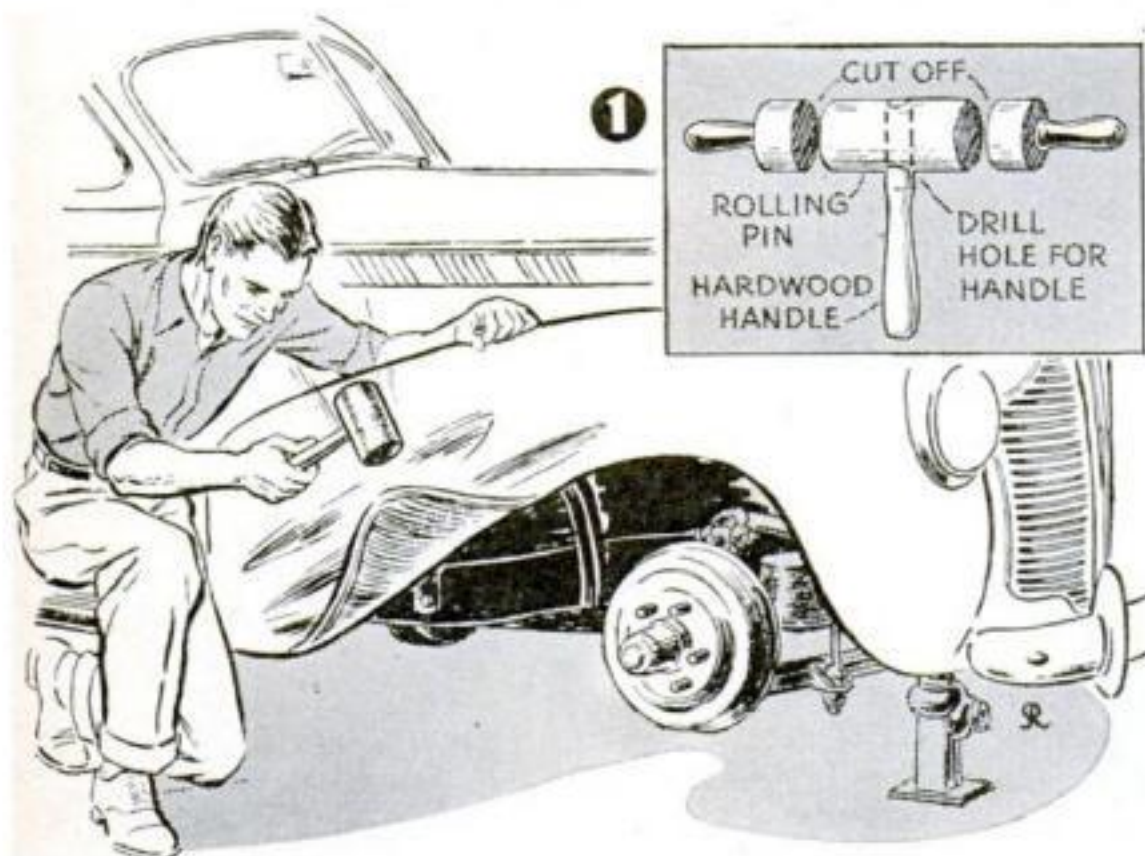
After the cross-country fun comes the hog wallow. It is the stiffest grind that the trucks have to confront.

Extra wheels are fitted on front axles. This is not only to add traction but to increase the strain on the front-end driving and steering (*Continued on page 232*)



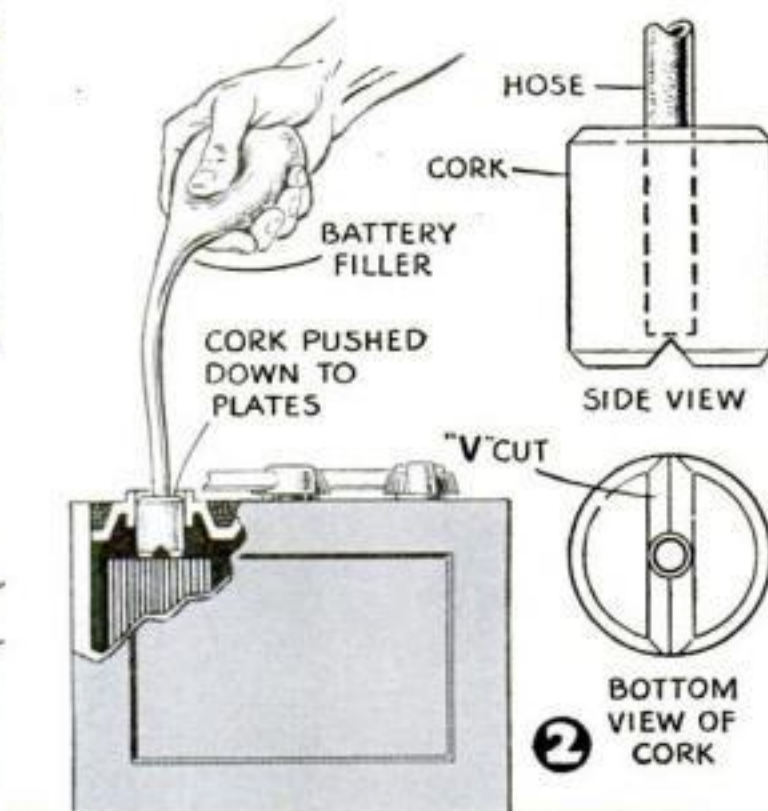
"General Mud" won't be able to stop an army whose transport has graduated from the Holabird bog

EIGHT TIMESAVERS

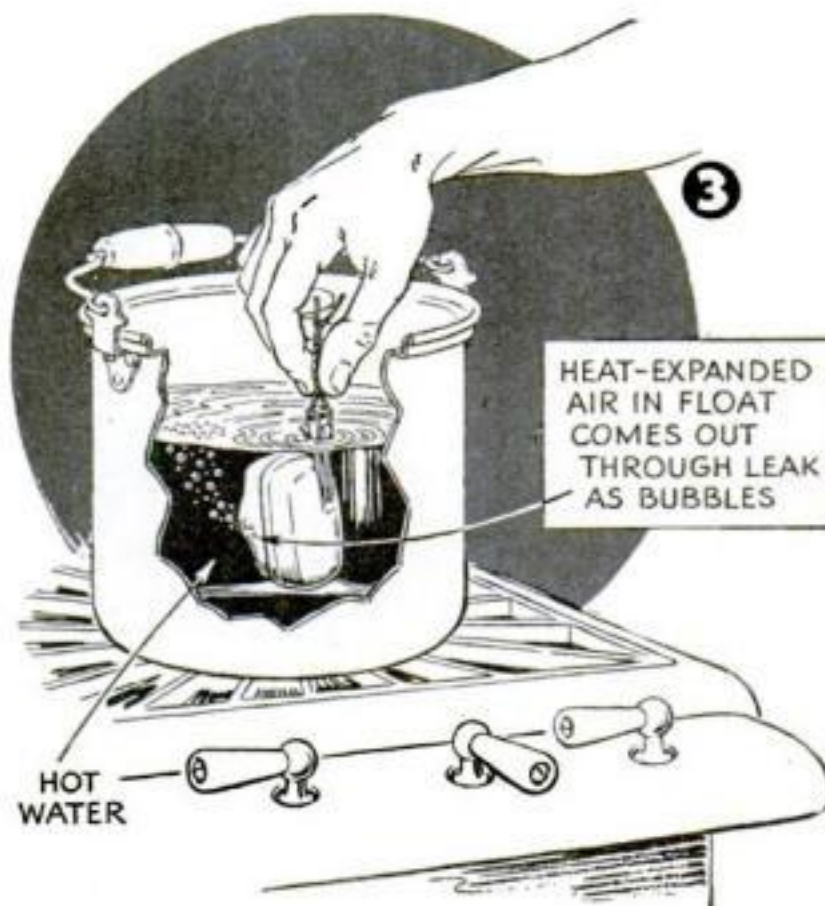


1 A GOOD WOODEN FENDER Mallet for hammering out dents in your car fenders can be made from an old rolling pin. Saw off both ends of the pin, leaving the center section about five or six inches long. Through the center of this, drill a one-inch hole at right angles to the axis of the rolling-pin section. Force a hardwood dowel tightly into the hole to provide a handle of appropriate length. I've been using such a mallet on fender work for a year and it is still good.—J. S.

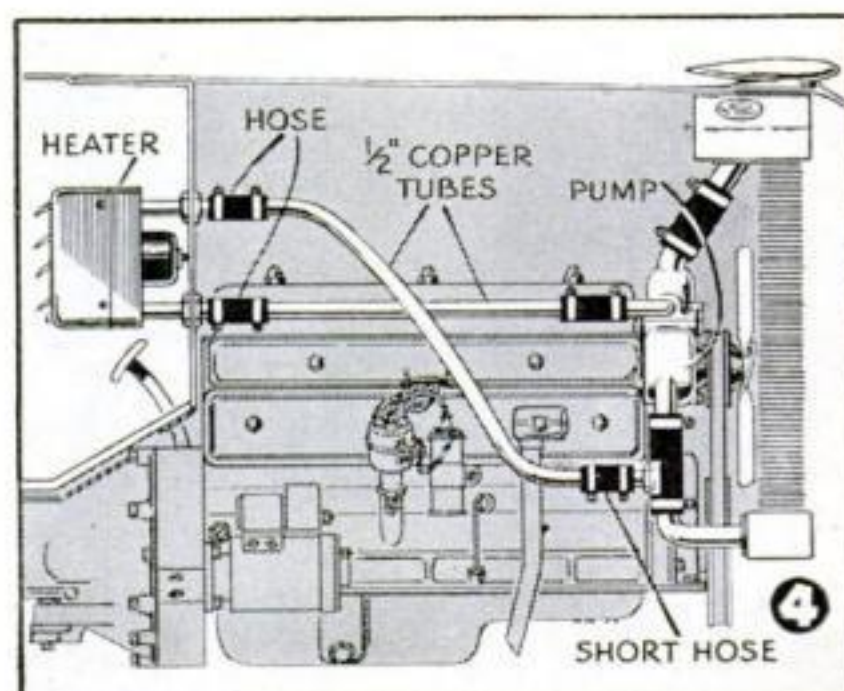
2 TO AVOID OVERFILLING BATTERIES when adding distilled water, get a cork from a gallon jug and cut it as shown to a loose fit inside the filler holes. Drill a hole through the center of the cork and insert the end of the battery filler hose, shellacking it in place. To fill the battery, insert the cork in each hole in turn, adding water until it just shows at the top of the filler hole. When the cork is removed, the water will drop the correct amount below the top.—P. M.



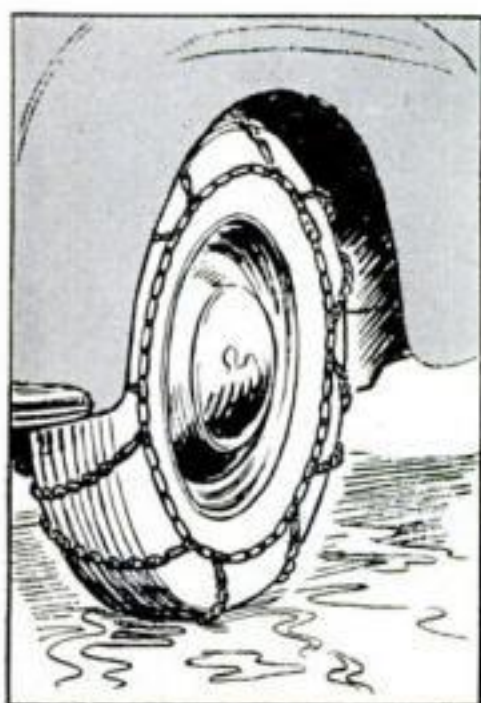
3 TESTING A CARBURETOR FLOAT for tiny leaks that require soldering is simplified by submerging the float in a pail of hot water. Heat instantly expands the air within the float, forcing it out through any holes, which can be readily spotted by the resulting bubbles.—A. H. W.



4 COPPER INSTEAD OF RUBBER TUBING will add greatly to the life of the water-supply system of your car heater. Half-inch tubing is easily shaped by hand to the required curves and readily cut to proper lengths. Short pieces of rubber hose are clamped to the tubing and fittings, providing flexible connections, and a neat job.—W. F. B.



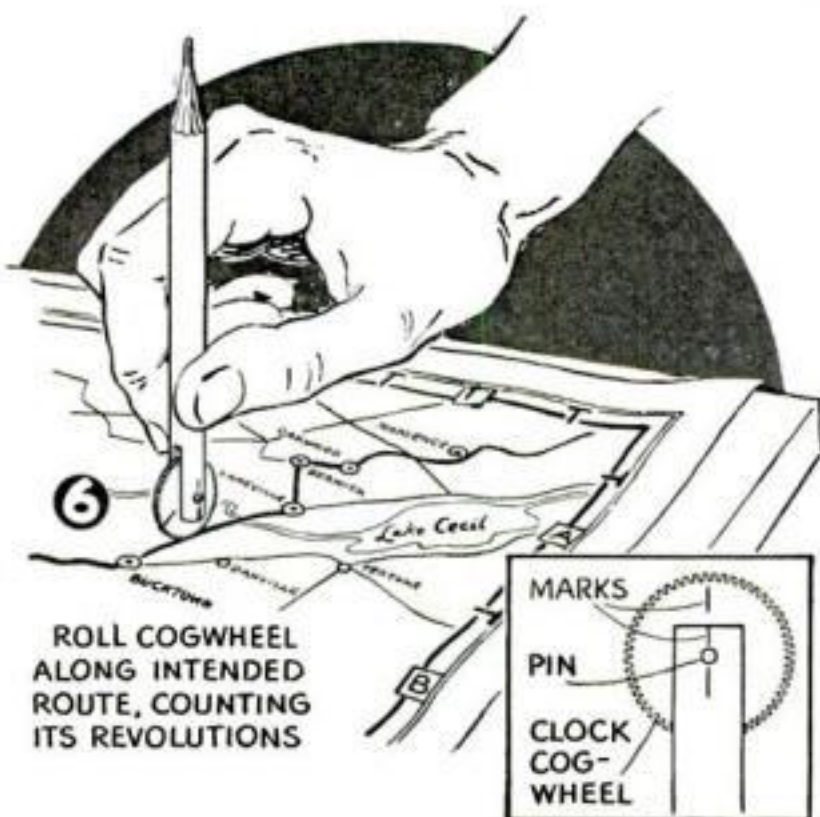
FOR CAR OWNERS



5 ATTACHING CROSS CHAINS DIAGONALLY REDUCES SIDE SLIP

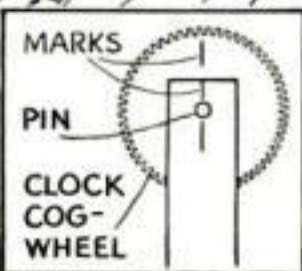


5 ZIGZAG CHAIN CROSS LINKS, I believe, offer greater resistance to side skidding on ice than straight-across links. An easy way to fix up conventional chains is shown in the accompanying illustrations. First unhook the cross chain at one side nearest one end, and attach it near the second cross chain. Then unhook the second cross chain from the opposite side and move it near the third cross chain. When you've come to the end, you may find that a few extra side links may be needed to make the redesigned chains fit the wheels.—H. W.



6

ROLL COGWHEEL ALONG INTENDED ROUTE, COUNTING ITS REVOLUTIONS



6 A MILEAGE ESTIMATOR for road maps can be made from a heavy drawing pencil, a cogwheel from an old clock, and a pin. Cut a slot in one end of the pencil, insert the cogwheel from which the shaft has been driven out, and insert the pin through a hole drilled through the pencil. Make a mark on the edge of the cog as shown. Now run the wheel over a planned route on the road map and count the wheel turns. Find out how many miles each turn represents on the map's scale, and multiply this by the wheel's turns.—F. G.

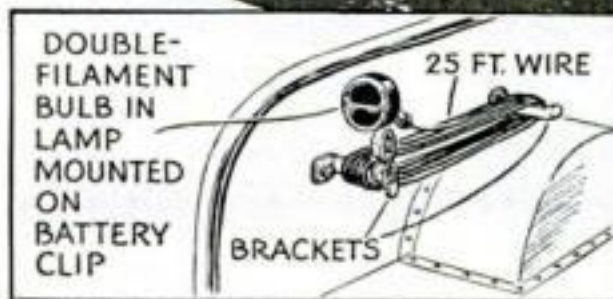
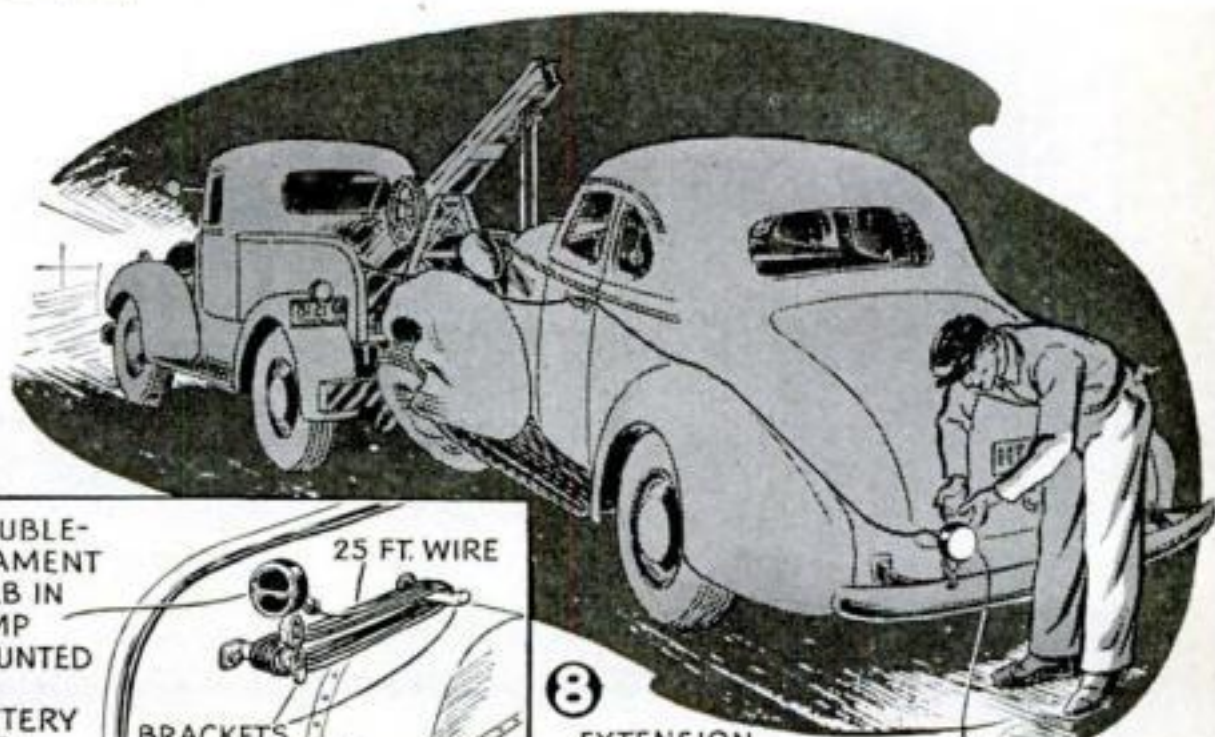
7 BLACKENED LIGHT BULBS SHOW UP QUICKLY if they are held against a white card in a good light. The entire bulb appears smoky if it has begun to age beyond the point of reasonably good efficiency. Oddly, the same bulb simply held up to the light may not show its condition at all.—W. A.



7

LAMP BULB

WHITE CARD



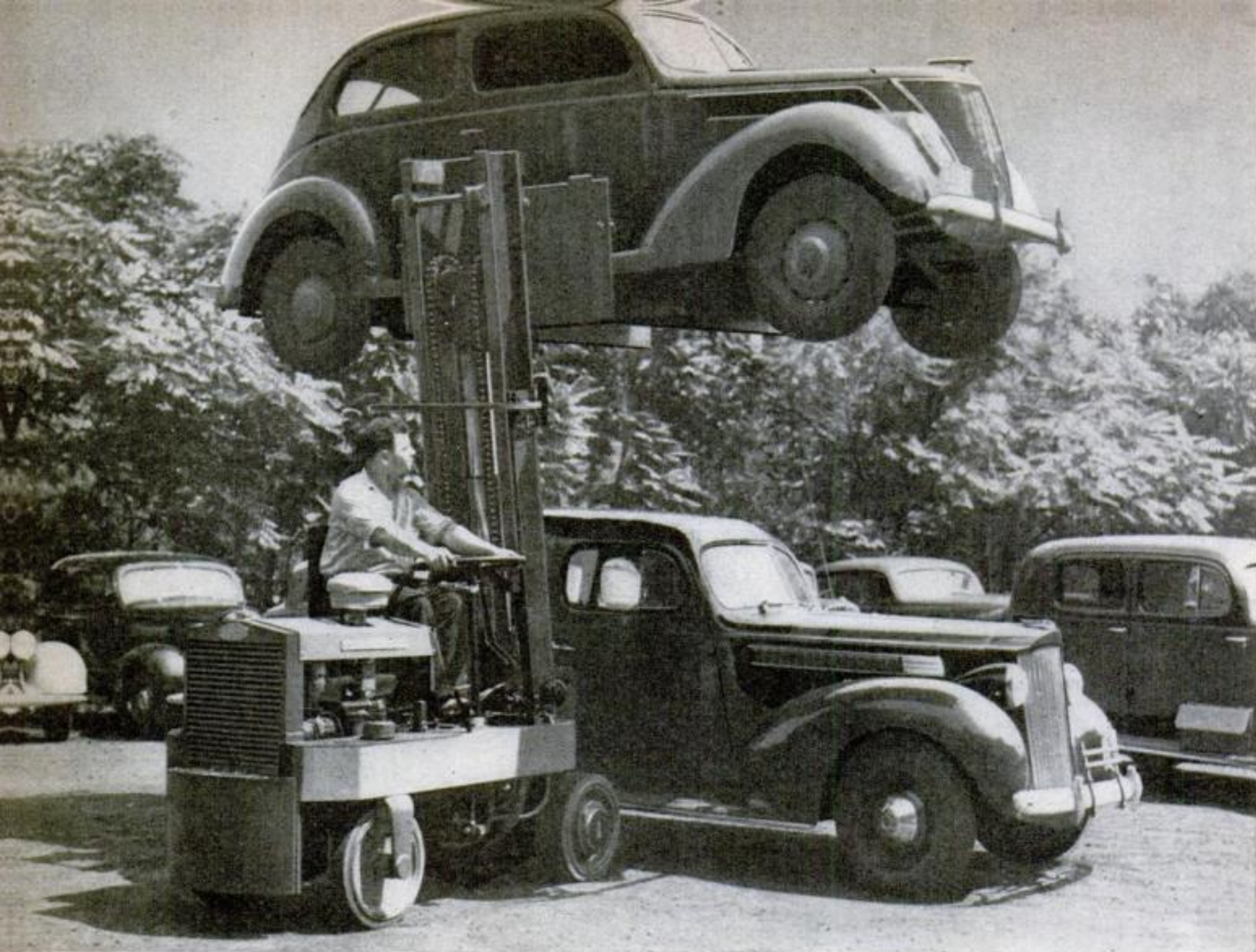
8

EXTENSION TAIL LIGHT CLIPPED ON BUMPER

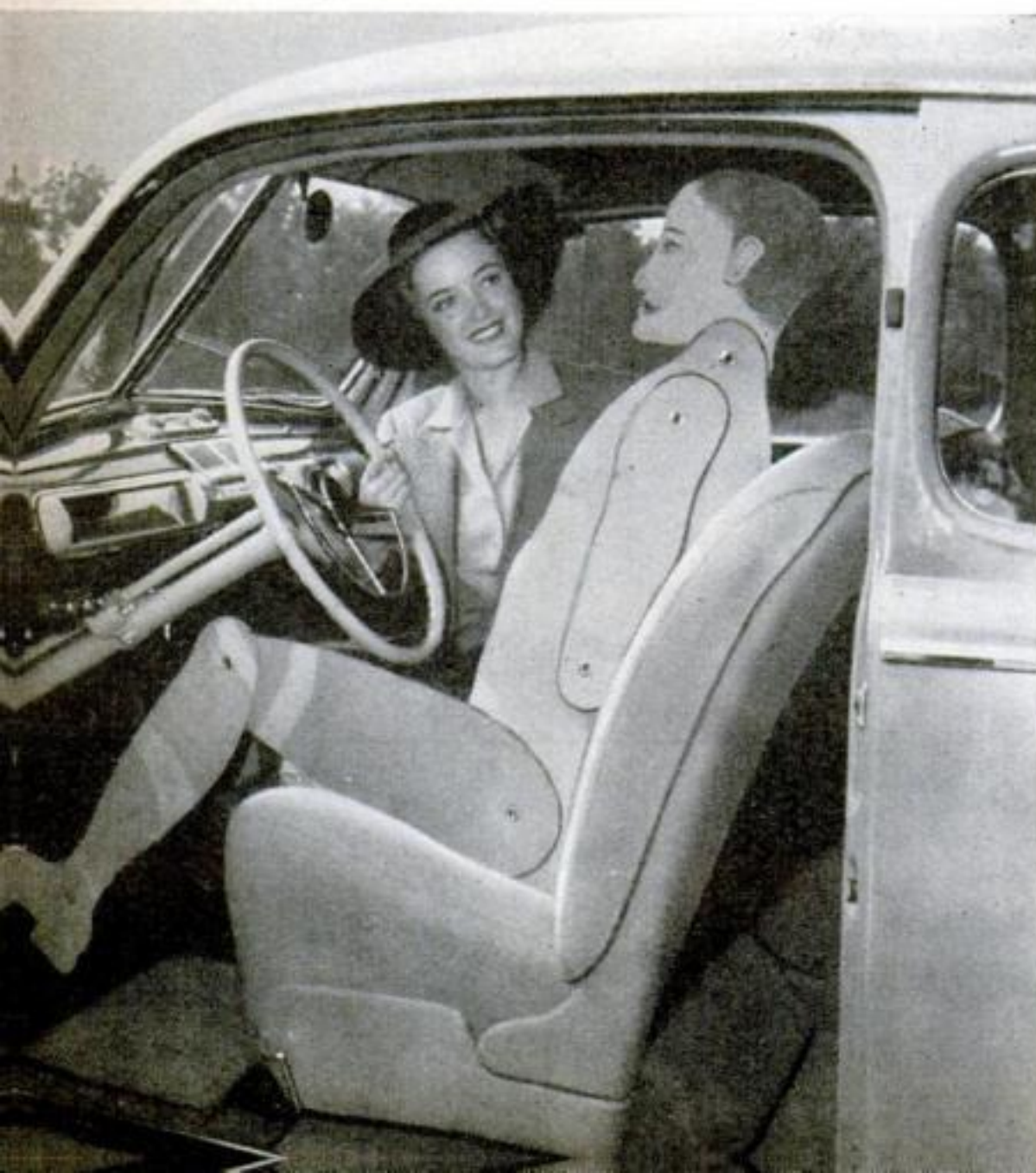
DOUBLE-FILAMENT BULB IN LAMP MOUNTED ON BATTERY CLIP

25 FT. WIRE

BRACKETS



PARKING TRUCK. Cars are lifted bodily more than nine feet into the air, carried over other autos, and deposited neatly in hard-to-reach spots by a truck designed for use in parking lots. The quick-acting hydraulic lift handles weights up to three tons



Auto Ideas

JOHNNY Q. CARDBOARD is an important figure in the design department of the Ford Motor Company. Representing a composite of the proportions of the average male American as revealed by government statistics, he helps engineers to locate seats to best advantage and to determine proper pedal reach, leg room, knee clearance under the steering wheel, and arm spread in reaching the instrument panel and window and door controls. In case you want to compare yourself with the average American, here are Johnny's measurements: Height, 5 feet, 8 inches; arm length, $32\frac{3}{4}$ inches; leg length, 32 inches; sitting height, $35\frac{3}{4}$ inches; location of knee, 2 inches above one half the total leg length. Made out of stiff cardboard, he is jointed at shoulders, elbows, wrists, hips, knees, and ankles

POPULAR SCIENCE

GUS cools a hot one

By MARTIN BUNN

It was a warm winter Saturday—one of those days we sometimes get in January which make you forget that spring is a long three months away and make you feel as restless as if it weren't.

Gus Wilson, standing at the opened shop doors of the Model Garage, looked out at the solid streams of traffic on the highway and said to his partner, Joe Clark: "Everyone who's got a car is out in it today. I almost feel like taking a ride myself."

Joe grunted. "This hasn't been much of a Saturday for us," he observed practically. "Aside from a few gallons of gas, I haven't made a sale since we opened this morning, and you haven't had a repair job in the shop. What the heck has happened to all the customers?"

An impatient honking of horns came from the highway. Gus laughed. "There's a customer out there now—that fellow with the trailer who's holding up the traffic. If he ever gets up his nerve to... He's done it!"

With horn screeching and hands waving excitedly out of both front windows, the car towing the trailer suddenly had cut across the stream of northbound traffic and was heading up the garage driveway. Gus and Joe stepped out as it came to a stop in front of the shop. They saw that it had Maine tags, that a stout gray-haired woman was knitting industriously in its front seat, and that its rear was well loaded down with corrugated boxes, battered suit cases, and an assortment of bundles—all topped off by an old baseball glove and a new and shiny baseball bat laid out as if ready for use.

A little old man hopped out of the driver's seat and came briskly around the front of the car. "You the proprietor here?" he wanted to know. Gus said that he was. "Well," the old fellow said, "my motor's red-hot, and I want to get it fixed up right away. I'm headin' for Florida, and I don't aim to waste any time gettin' there. The boys'll be wonderin' what's happened to me, and the team can't get in any good work-outs 'til I get there to help 'em out."

"Huh?" Gus said. "What team is that?"

"What team?" snapped the old fellow. "The Saint Pete Colts—a baseball team, and a durned good one! I play shortstop—name's Bill Perkins—and I can hit a good lick too, when I get up there at the plate."

He broke off to glare at Joe Clark. "What you starin' at, young feller?" he demanded. "You've heard tell of the Saint Pete Colts, ain't you? Every player over seventy, and able to give these young squirts who think they can play ball more'n they're lookin' for! It's the climate down there does it! Why, in that Saint Pete sunshine . . ."

"Yes, I know," Gus hurried to agree. He had learned never to let a tourist get started on the Florida or California sunshine. "I'll try to get your car fixed in a hurry. Just drive it in. Maybe the lady would be more comfortable waiting in the office."

"Her?" Perkins said. "Oh—she'll be all right. I'll unhook the trailer, and she can sit in it out here. She's knittin' for the Red Cross, and she don't want to lose any time."

He unhooked the trailer, and Mrs. Perkins smilelessly transferred herself to it without missing a stitch.

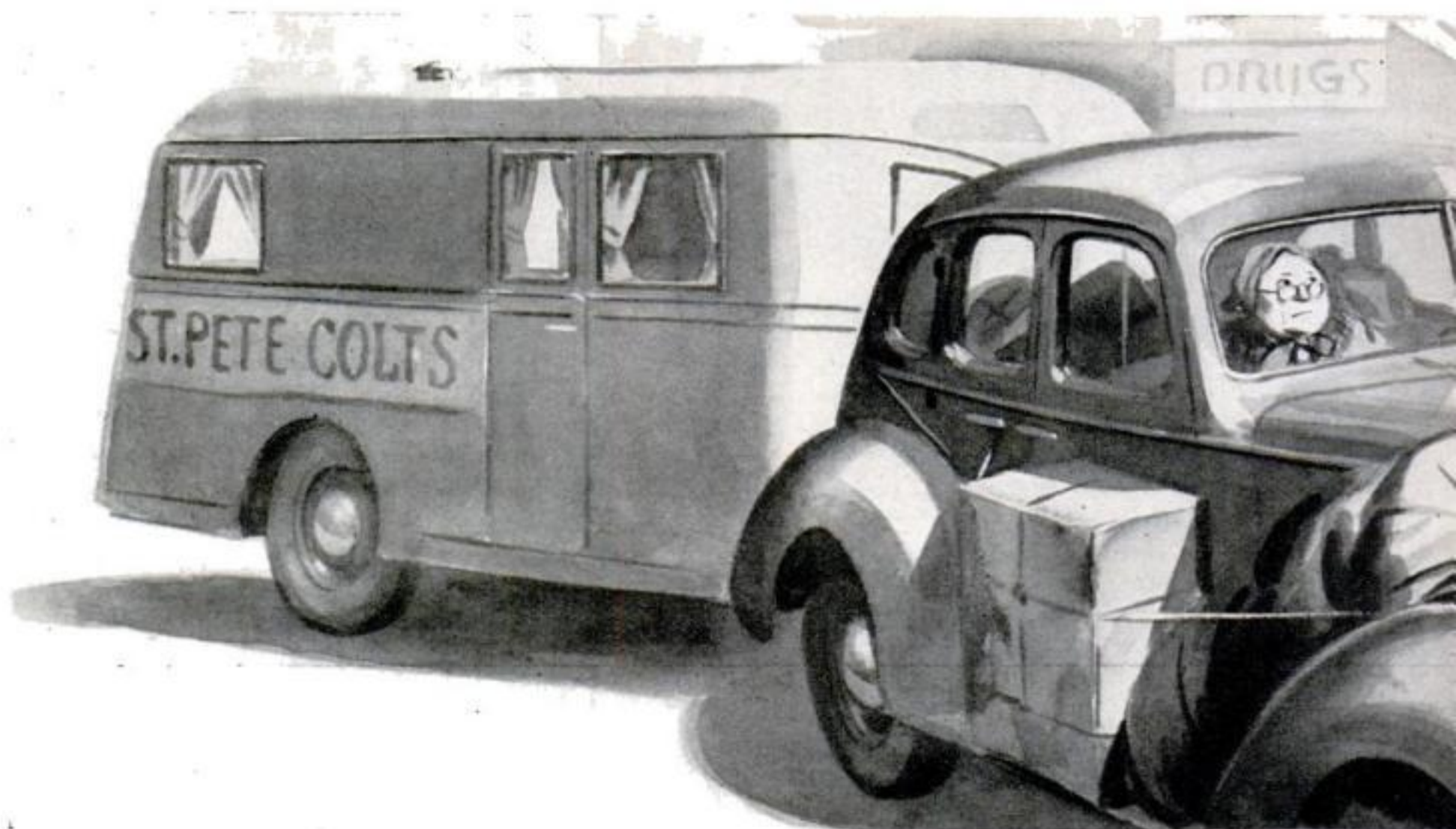
"When did your engine start to heat up?" Gus asked after the new customer had driven into the shop.

"Been doin' it all day, on and off like," Perkins said. "That's why I'm behind schedule—stoppin' every half hour or so to let the motor cool off."

Gus glanced at the pile of baggage in the rear of the car. "Loaded just a little heavily, aren't you?" he asked diplomatically. "That



Gus played the air stream over the core. Joe ducked, but not fast enough as dust, dead bugs, and leaves flew out of the car radiator



will make an engine heat up sometimes."

"I ain't loaded any heavier than I've been on other trips, and I never had a speck of trouble before," Perkins asserted. "Say, mister, I'm right sharp set. Anywhere around here I can get a bite to eat?"

"There's a diner a couple of blocks down the highway," Gus told him.

"I got an appetite like a growin' boy's," the old fellow boasted. "While you're findin' out what's the matter with my car I'll go down there and get me a couple of hamburgers and a slice of pie."

"I never saw anything like that before, darned if I did!" Joe Clark said after he had departed. "Playing baseball and eating hamburgers and pie when he's over seventy!"

Gus grinned. "Well, let's see what's the matter with Shortstop Perkins's bus—I'll bet that its circulation isn't as good as its owner's!"

He raised the hood and examined the fan belt, then rotated the blades a few turns. "Start her up, will you, Joe?" he asked.

Joe got into the car and stepped on the starter, then let the engine idle. "The fan's working all right," Gus observed after a few moments. "Step on her, Joe—shoot her up to about forty-five." He watched the fan again, then held his open hand near the front end of the engine. "All right, switch her off," he said. "The fan's all right, but in spite of that there isn't much of a breeze coming through the radiator. Probably its air passages are partly clogged."

"You're working on this job wrong-end-to, aren't you?" Joe asked. "I thought that the

first thing you always check on an overheated-engine job is the water circulation."

"A lot of mechanics do," Gus said. "I don't, because I've found that checking the air circulation often is a short cut to finding the trouble. There are at least 50 conditions which will cause an automobile engine to overheat, and pretty nearly every one of them causes it to overheat because, directly or indirectly, it interferes with the easy dispersion of heat from the engine into the water and then the air. Let's have that air hose, Joe."

HOLDING the nozzle of the hose close to the engine side of the radiator core, he turned on the pressure, then began to play the air stream over the core. Joe ducked, but not fast enough, as dust flew out of the front of the radiator, followed by an accumulation of dried-up leaves and long-deceased bugs. "There you are," Gus said. "That trash explains why, although the fan was performing perfectly, there wasn't much of a breeze coming through the radiator."

"Your short cut made good that time," Joe conceded, still brushing himself off. "You certainly made a short job of curing Mr. Perkins's trouble."

"It isn't cured," Gus said unexpectedly. "That partial clogging of the radiator air passages would cause some overheating of the engine, but not nearly enough to make the addition of water every half hour or so necessary. Start her up again, Joe."

Joe started the engine, and Gus took off



A little old man hopped out of the driver's seat and came briskly around the front of the car. "My motor's red-hot," the old fellow said, "and I want it fixed up right away. I'm headin' for Florida!"

the radiator filler cap. "Speed her up to about 45," he said. There was no noticeable change in the water level in the filler pipe.

"Is the radiator clogged up, after all?" Joe asked, taking his foot off the accelerator.

"Get out and stand here while I speed her up," Gus told him. "Now watch that lower water hose—see how it collapses when I accelerate the engine? The trouble isn't with the hose—it's almost new. What's the matter is that the radiator core is partly clogged, so that the pump draws faster than the core can deliver water to the hose. The result is that the suction of the pump sucks the hose inward, cutting off all the water. I'll have to check the radiator." He drained the radiator and removed the hose.

"Guess Mr. Perkins will have to wait while you reverse-flush the radiator," Joe remarked.

"I DON'T want to hold up the old boy any longer than I have to—not when he's just aching to get cavorting around the diamond," Gus said. "Maybe I can do the job without reverse flushing. If the clogging was serious enough to require that, I'd have to do the water jackets, too, to make a decent job of it." He carefully examined the length of hose he had removed, and then took it over to his workbench. "I'll put a wire coil spring inside this. That will keep the hose from collapsing and will allow the

water pump to suck steadily—and that may clean out whatever is obstructing the radiator core."

He replaced the wire-reinforced hose and refilled the radiator with the antifreeze mixture he'd removed. Then he checked the entire water line for leaks. "Tight as a drum," he said. "Start the engine."

He had Joe run the engine at low speed for a few minutes. Then he told him to speed up to 45 again. This time the hose did not collapse, and instead of overheating, the engine stayed noticeably cooler.

"That did the trick," Gus said. "And here's Shortstop Perkins."

When Gus told him what had been wrong, Perkins looked almost disappointed. "Shucks," he said. "Just a little thing."

"Yes, just a little thing," Gus agreed. "But when you multiply a little thing by three you get the equivalent of a big thing—something big enough to lay your car out at the side of the road!"

"What do you mean, three?" Perkins demanded. "There were really only two things wrong—radiator clogged up outside, and radiator clogged up inside."

"You've got your car badly overloaded, and you're towing a trailer behind you," Gus reminded him. "That, by itself, probably wouldn't have been enough to make your engine heat up so much that you would notice it, but added to the clogged radiator it made it heat up plenty."

JIMMIE LYNCH GIVES

Seven Rules

RULE 1



1 To bring a car out of a skid, turn the steering wheel in the direction the rear of the car is skidding and step on the gas

2 For control in quick stops, apply and release brakes several times. Don't release the clutch until slowed to 15 miles an hour

3 If you run into a curve too fast, place left foot on brake and keep right foot on accelerator. Depress the brake slightly and feed ample gas all the way around curve

4 Before passing another car, think of the time element. It takes as long to pass a car doing 50 miles an hour as it does to pass ten cars parked bumper to bumper at the curb. Head-on collisions are the most severe

5 If a tire blows, never jam on the brakes. No matter how fast you're going, step on the gas instantly and pick the speed up at least five miles an hour to bring the car out of the swerve caused by the blow-out. After the car's course is straightened out, bring car carefully down to a gradual stop

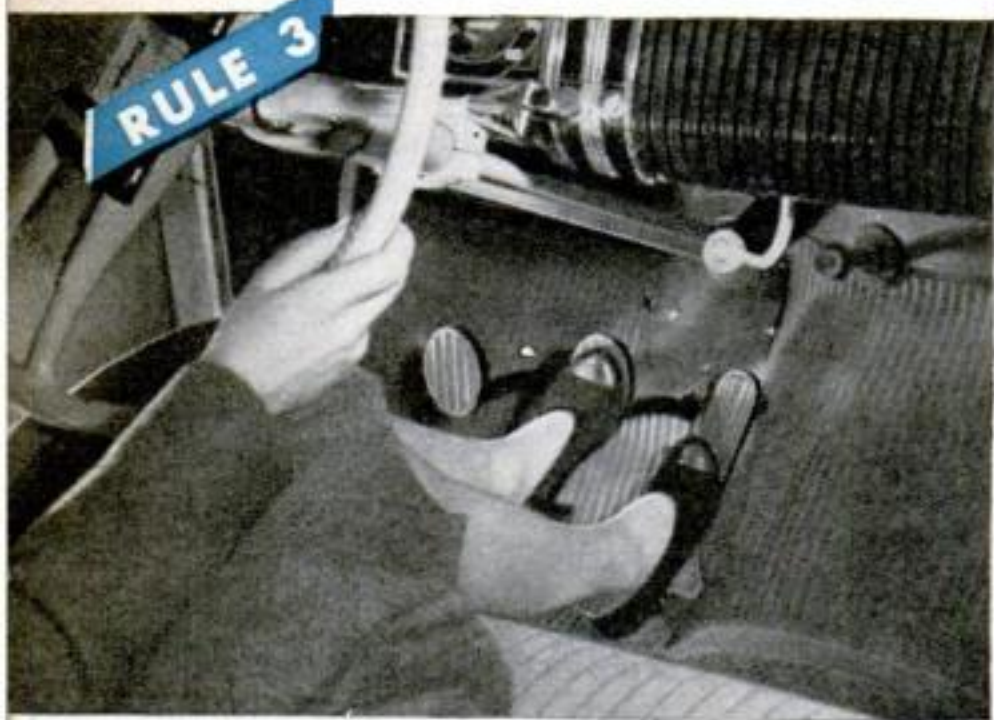
6 You should always keep your best tires on the rear, because if a rear tire lets go, it throws the car off balance much more severely than if a front tire should blow. In the long run, the safest arrangement is to have good, safe tires on all four wheels

7 After an upset or collision, do not turn off the ignition. If motor has stopped, get it started again at once and hold the foot accelerator down to the floor. Thus, if a fire has started near the carburetor, the flames will be pulled into the engine

RULE 2



RULE 3



RULE 4



for Safety

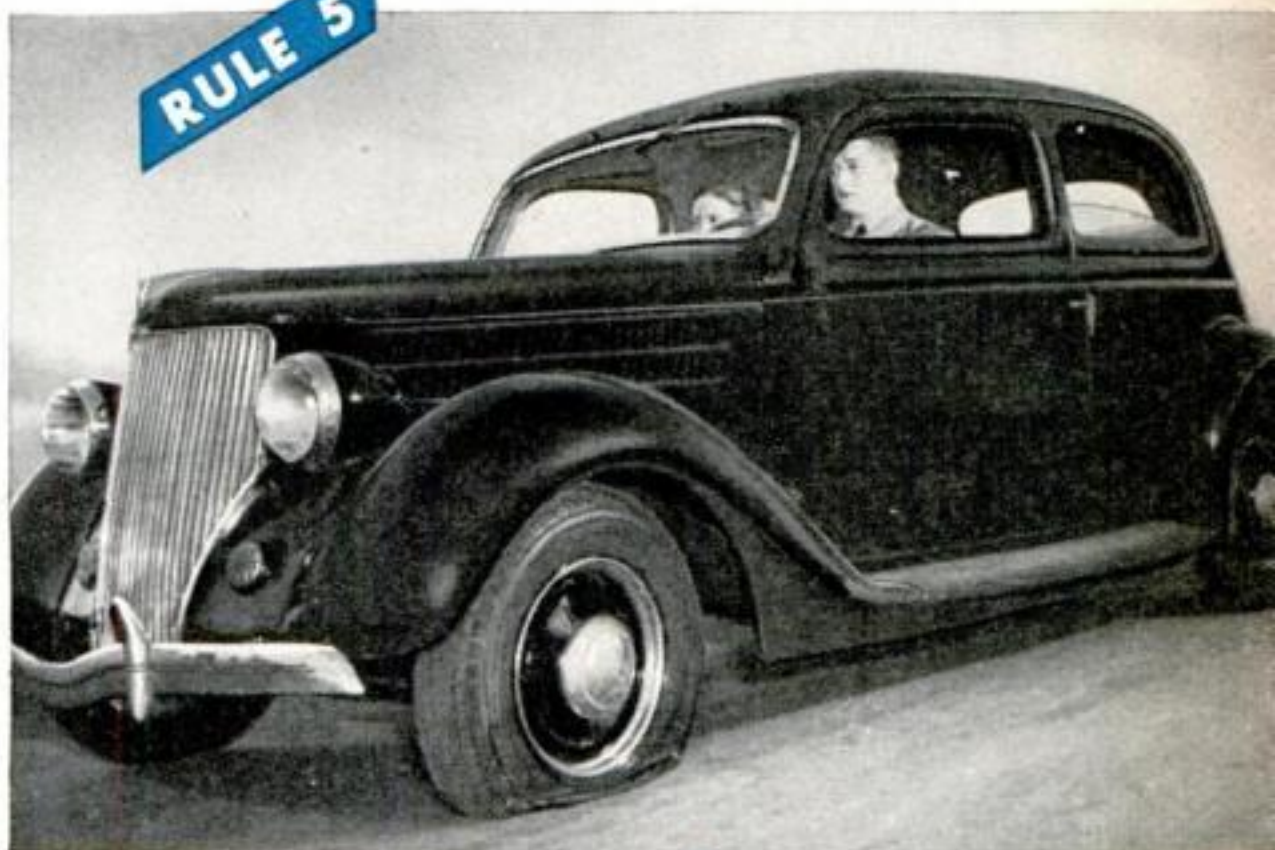
MOST car accidents can be avoided. Jimmie Lynch, maestro of stunt drivers, thinks so, and he ought to know. Repeatedly, as many as 70,000 people a day have watched him and his staff of skilled drivers come through unscathed from dozens of hair-raising but deliberately planned predicaments that would make ordinary drivers give up the ghost.

Jumping cars over hurdles consisting of other cars, hurling them through flaming hoops, and piloting them precariously balanced on one front wheel are stunt drivers' jobs. Believing Jimmie could furnish tips to aid everyday drivers in highway emergencies, *POPULAR SCIENCE* asked him for some. Obliging, he came up with a set of seven rules which are the scientific fundamentals of his own skilled technique. In the series of pictures on these pages, Jimmie and two of his crack drivers, Neil Oldfield, nephew of Barney Oldfield, and pretty Betty Middleton, illustrate his seven rules.



MAESTRO JIMMIE LYNCH deliberately puts himself into more driving jams in one day's work than the average car user encounters in a lifetime. On these pages, he gives some tips that might come in handy in an emergency

RULE 5



RULE 6



RULE 7



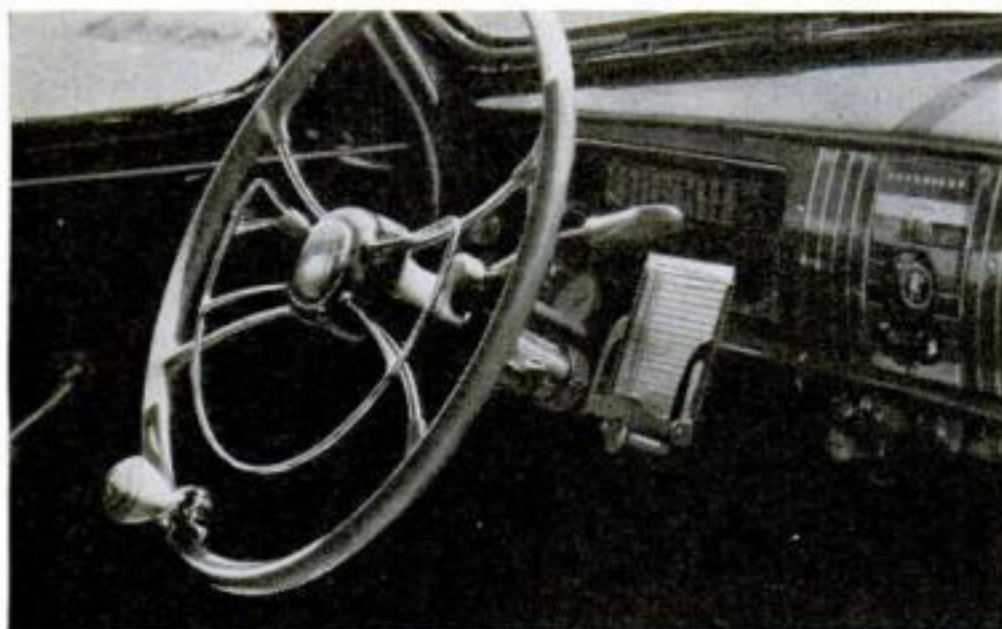
Auto Ideas

Tests on Wobble Road Aid Driving Comfort

ADD to the tortures that new-model cars undergo the wobble test! Racing over a double line of staggered concrete mounds, a Ford-made car at the company's proving grounds at Dearborn, Mich., is shown with two wheels completely off the ground.



Giving a car the works in proving-ground tests of its springs



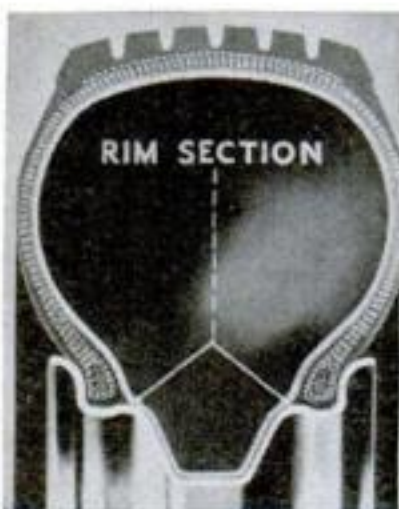
How the pad is held by its bracket on the steering column

Pad on Steering Column Provides Auto Desk

ATTACHED to the steering column of your car within easy reach, a handy pad with lined spaces for entering such items as mileage, expenses, dates, and other trip data is now available. The replaceable pads slide into a special holder that permits writing directly on them. In addition, a double-armed spring clip lifts when needed to grasp and firmly hold cigarettes, pipes, salesmen's order books, or road maps.

New Rims Grip Tire Despite Blow-Out

AS A special safety feature, the wheel rims of Chrysler-built cars are designed with indentations in which the tire beads anchor themselves so firmly that even a wholly deflated tire, it is claimed, cannot slip out of place. On the Plymouth shown at the right, a completely flat tire is said to give the same driving effect at forty miles an hour or faster as one inflated to ten pounds pressure. Thus, a sudden blow-out on a speeding car would not throw the tire from the rim, and the car could be brought to a safe stop. Tire-changing tools also have been improved, and the illustration shows a device which simplifies that operation, often so uncomfortable.



Note how the tire beads fit into grooves on the rim of the wheel



A special tool makes it simple to remove the tires

HOME and WORKSHOP

KITCHEN

DINING ROOM

LIVING ROOM

BATH

PORCH

Announcing:

\$1000

HOME PLANNING CONTEST

How would you plan
"The Home You'd Like to Build"

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7-8

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How would you plan
Home You'd Like to Build"



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HOME PLANNING CONTEST

How would you plan
Home You'd Like to Build"



ME PLANNING

How would you plan
"The Home You'd Like to Build"

A stylized illustration of a balance scale. The scale has a horizontal beam supported by a central fulcrum. On the right side of the beam, there is a weight. The background is a solid blue color. The scale is tilted slightly upwards on the right side.

**\$1000
CONTEST**

The Home You'd Like to Build

TELL US ABOUT IT IN YOUR OWN WAY
AND ENTER OUR \$1000 PRIZE CONTEST

HAVEN'T you often wished you could redesign the house you live in, or, better still, build a new house based upon your own ideas and perfectly adapted to the needs of your family? Even if you are an apartment dweller, the thought must have occurred to you on many occasions that planning and building a home would be a happy adventure.

We should like to see you do some planning along these lines right away. So, to encourage you to make a beginning and get your ideas down on paper, POPULAR SCIENCE is offering the following awards:

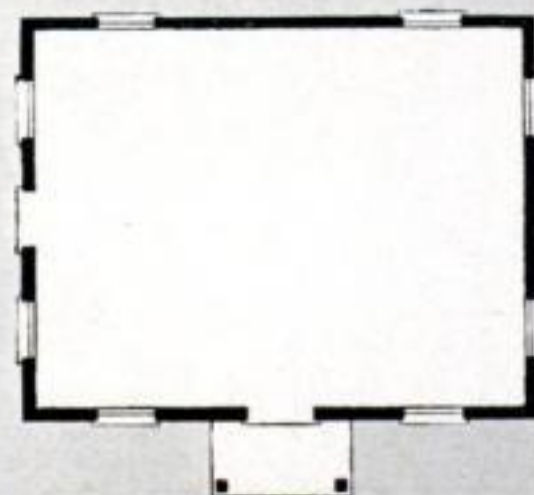
FIRST PRIZE—The services of an outstanding architect (or any architect of your own choice) to draw the plans and supervise the building of your home, or, if you prefer, a cash award of	\$500
SECOND PRIZE	200
THIRD PRIZE	100
FOURTH PRIZE	50
FIFTH PRIZE	25
25 PRIZES, \$5 each	125
TOTAL	\$1,000

It should be noted that the winner of first place will have the option of taking the \$500 prize in cash or of having the services of an outstanding architect to draw the plans and supervise the construction of the house, in which case the architect's bill will be paid in full by POPULAR SCIENCE. The other awards, however, will be made only in cash.

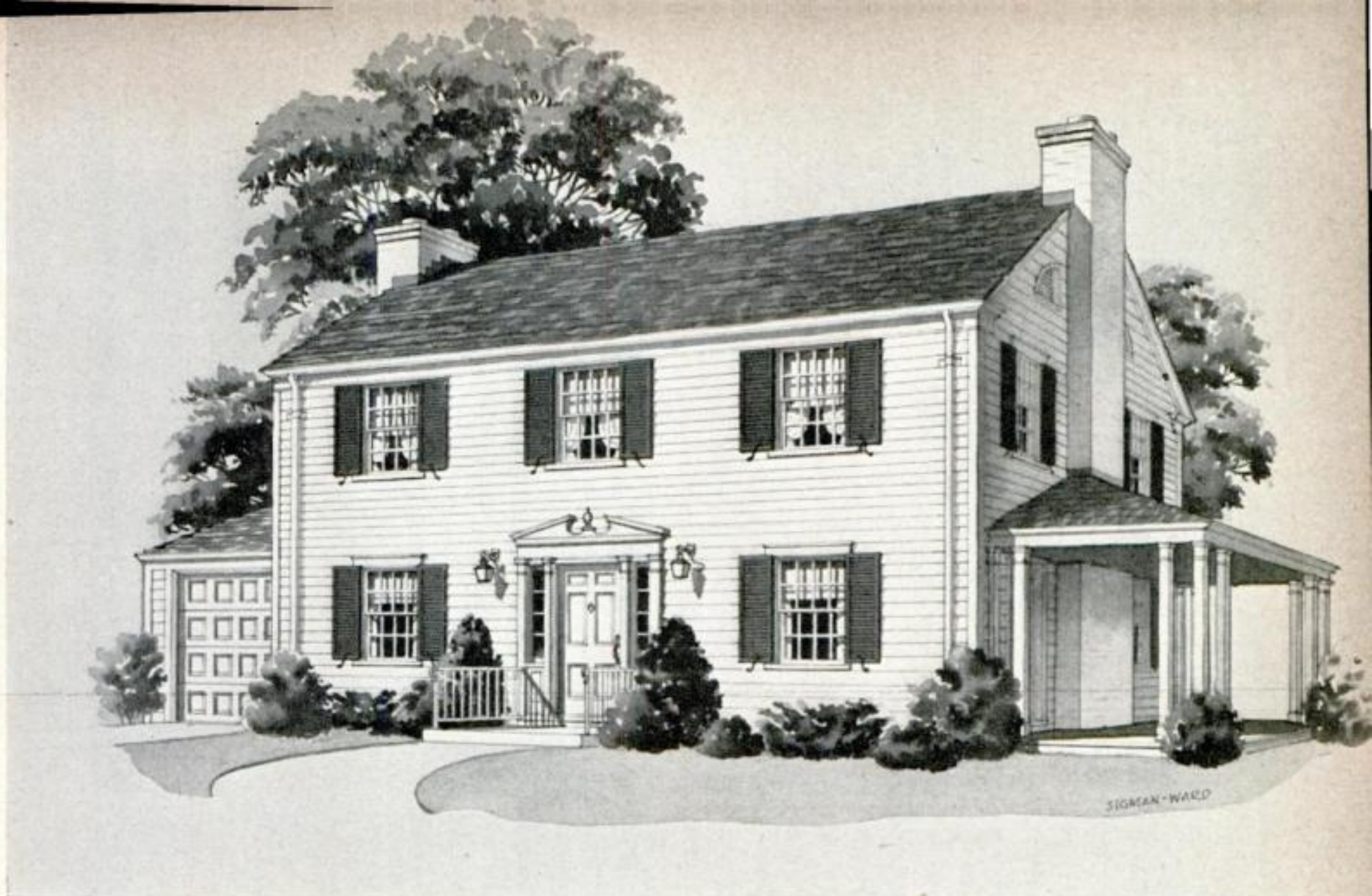
This is a contest of ideas, and every one will have an equal chance to win a prize. You do not need to be a draftsman or to have any specialized knowledge of building construction. There is no necessity to dress up your entry with ornamental drawings, to build a model of the house, or to waste any time merely in making your work look impressive. No technical background of the building trades is required. What we are asking for is nothing more or less than a clear, common-sense answer to these questions:

1. How would you plan the rooms in the house for the utmost convenience and satisfaction of your own family, under local conditions and within the limitations of your own income?

2. What materials would you select?



Modified Colonial, 12,000
cubic feet, cost \$4,200



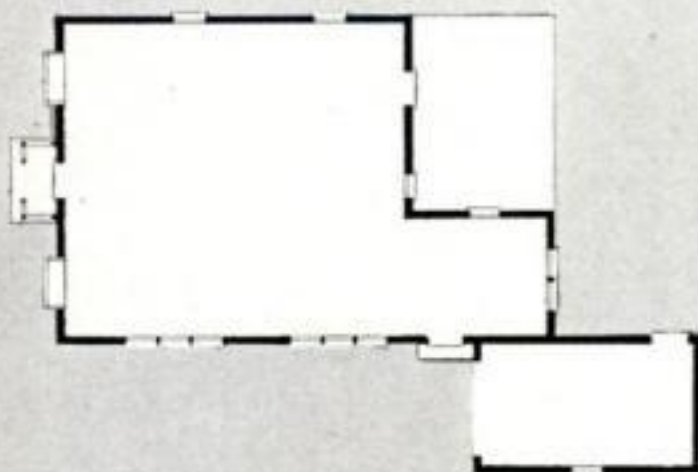
New England Colonial home of 27,000 cubic feet. At 35 cents a cubic foot, the estimated cost is \$9,450

3. What type of equipment and conveniences would you install?

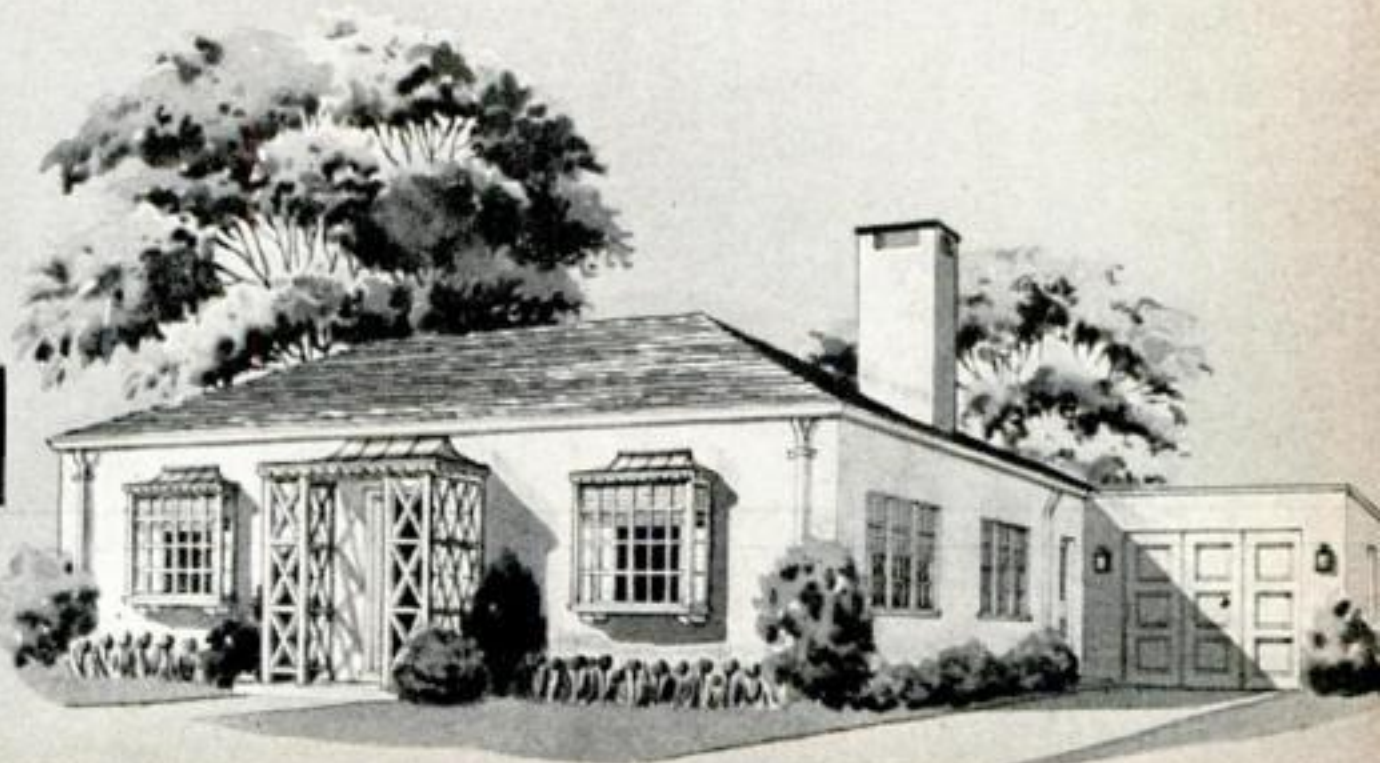
You can write your own ticket for all of this except that the size and price of the house should be kept within moderate bounds. For example, we have shown on these pages five typical small homes with accompanying floor plans, which have purposely been left blank so as not to influence your thought on the best division of the rooms. The smallest home—a sort of modified Colonial design—contains 12,000 cubic feet, and at 35 cents a cubic foot would cost \$4,200 to construct. The price might vary a good deal, of course, in different parts of the country and would also depend

to some extent upon the type and quality of materials used, the equipment included, and other factors.

The next home is Californian in design and contains 15,000 cubic feet, which on the same cost basis amounts to \$5,250. The Cape Cod house on page 142 has 18,000 cubic feet and, at 35 cents a cubic foot, could be built for \$6,300. The fourth one, which might be described as an Early American farmhouse design, contains 23,000 cubic feet, and the estimated cost of construction is \$8,050. Finally, the New England Colonial design above has a cubage of 27,000 and at the same base rate could be built for \$9,450. It is clear, therefore, that a roomy, com-



California style, 15,000 cubic feet, cost \$5,250



\$10000 CONTEST

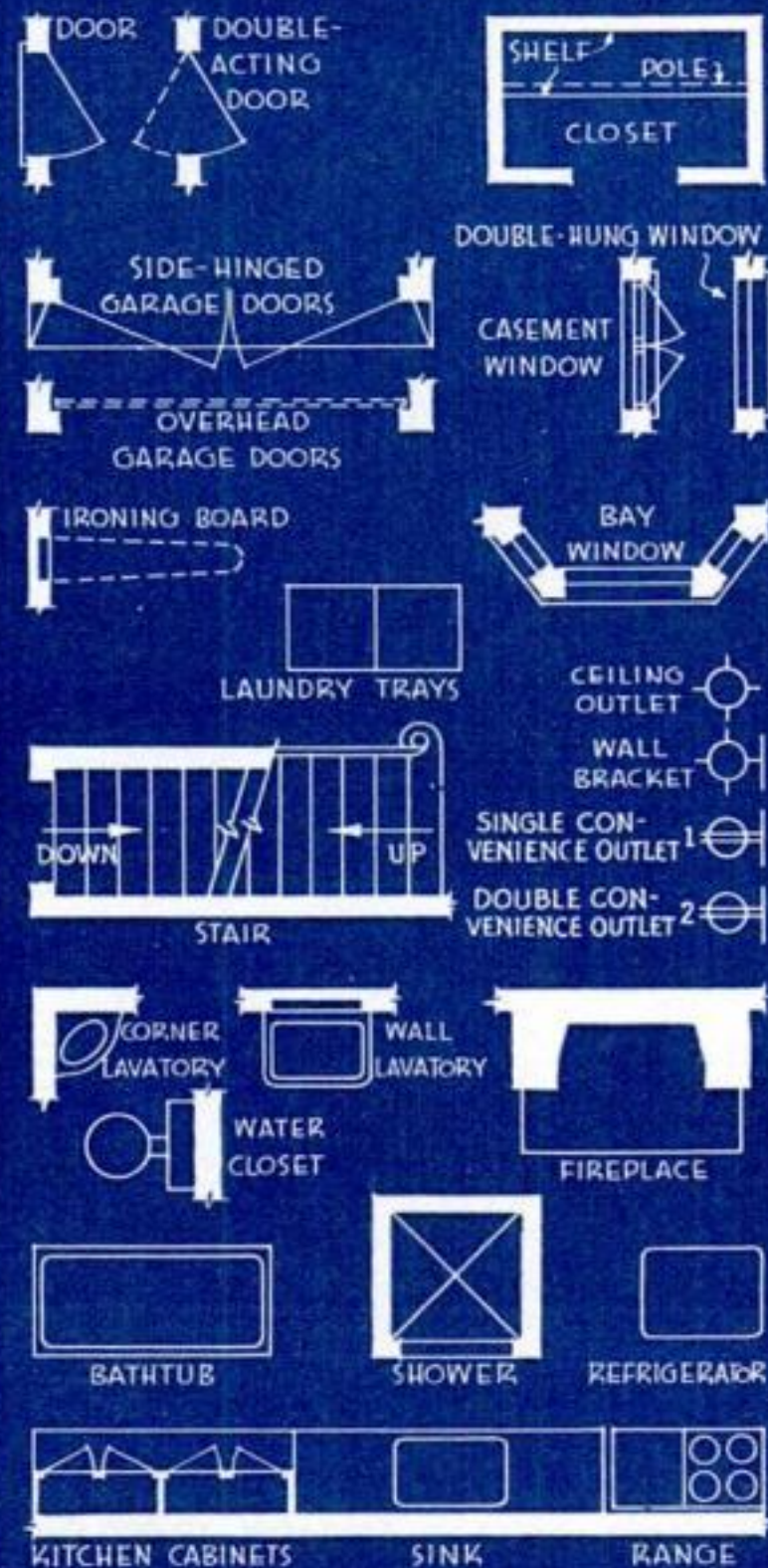
fortable and very well-equipped home can be built for \$10,000 (without counting the land), so contestants should keep strictly within that price.

Planning a house is as fascinating as a game and a thousandfold more practical. You have certain elements to start with—the size of the family, the annual income, the size and location of the plot of ground on which the house is to be built. Then you have a variety of things you would like to incorporate in the plan, and every member of the family is likely to have something to say about that. Billy and his sister may have their hearts set on a game room; Aunt Mary may want a sewing room with a convenient corner and outlet for an electric sewing machine. Possibly the "Mrs." finds it exhausting to climb stairs and insists upon a bungalow. Dad needs plenty of room for a shop in the basement and has perhaps determined upon an attached garage, which can be kept warm and comfortable through the winter.

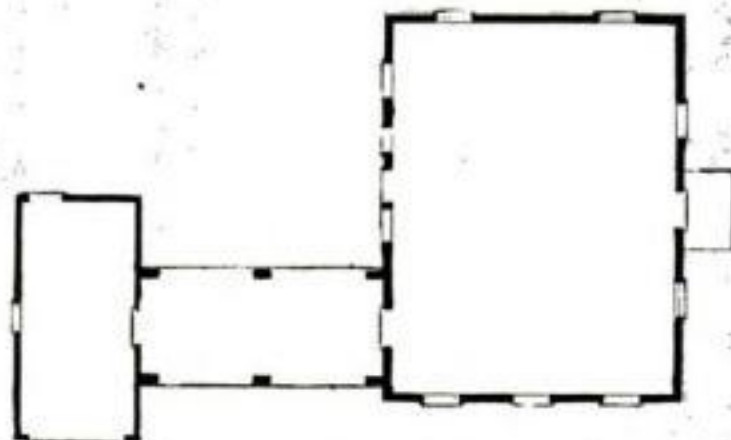
At any rate, there will be a lot of elements like these, not to speak of the question of what kind of heating plant to install, what sort of sink and refrigerator to buy for the kitchen, whether or not a dish washer is needed, how the water is to be heated, whether there is to be more than one bathroom and the type of fittings to select, how much of a laundry is to be put in and what kind of equipment should be chosen for it, what sort of floors and floor covering are to be used, and how the floors, walls, and trim are to be finished.

When you begin to play around with all the possibilities, you will realize better how much like a game—or perhaps a puzzle—it is. One circumstance can change the entire plan. For example, if the plot of ground—be it real or imaginary—faces the south, a good design will take that into consideration

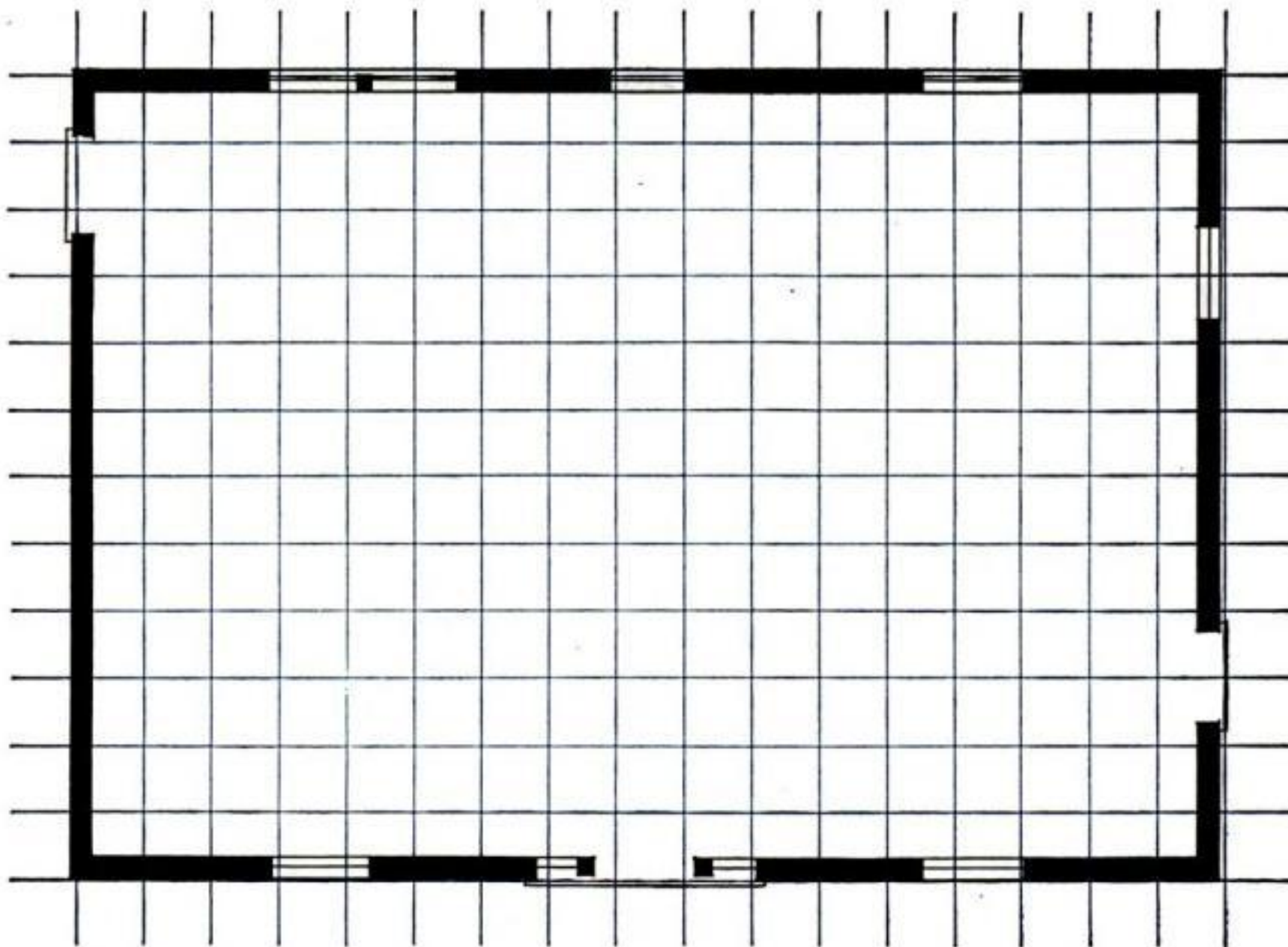
ARCHITECTS' AND BUILDERS' SHORTHAND



These building-construction symbols are easily made and will save time in preparing floor plans



Cape Cod style, 18,000 cubic feet, cost \$6,300



EACH SQUARE EQUALS 2'-0"

A blank floor plan you may use for planning room arrangements. It is the \$9,450 house on page 141

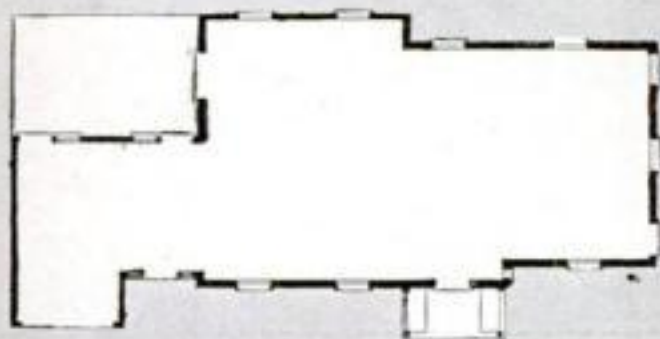
and, therefore, be very much different from a similar plan developed for use on a plot that faces the north.

You will find it a lot of fun to study all the possibilities in the light of your own personal and family needs. To make matters a little easier, we have prepared one blank floor plan and divided it in two-foot squares. You can lay tracing paper over this, if you wish, and work out various room divisions. When you have an arrangement that meets with your entire satisfaction, it can be redrawn larger and more clearly and

submitted as your entry along with the other information mentioned in the rules.

You are under no obligation, however, to use this blank plan or any of the four smaller plans, because you may prefer a house of a different shape. All we ask is that you submit plans of each floor, including the basement.

Please understand this: we don't expect you to be an architect. It is as unwise and costly for a man to attempt to be his own architect as it would be to be his own doctor. What we want are the sort of sketches and

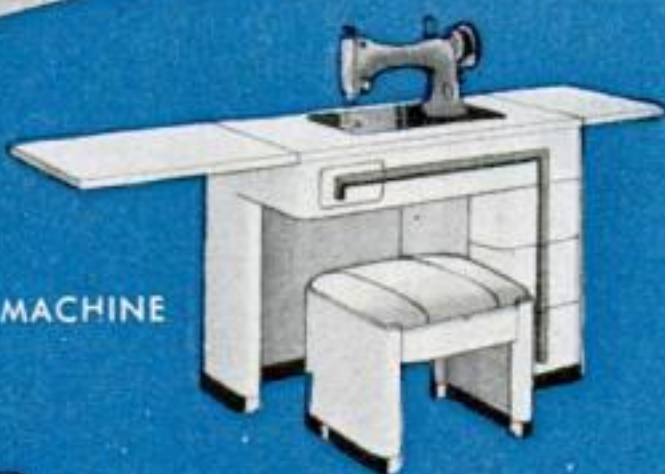


Rural Early American style,
23,000 cubic feet, \$8,050





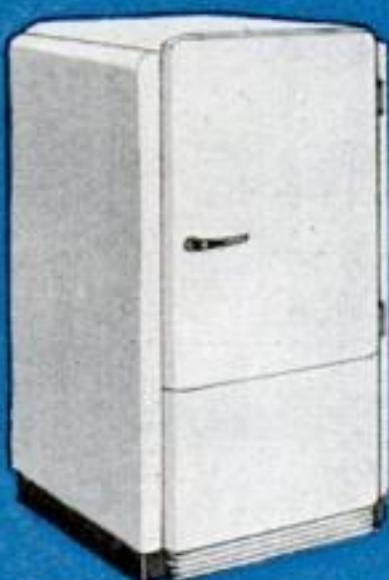
GLASS BLOCKS



SEWING MACHINE



RANGE



REFRIGERATOR



DISH WASHER
AND SINK



BATHTUB



LAUNDRY TUBS



FURNACE

Check List

FOUNDATIONS

Brick; poured concrete or concrete blocks; field stone.
Also: Mortar; waterproofing; termite shields.

WALLS

Wood, asbestos, or asphalt siding or shingles; solid brick or brick veneer; poured concrete or concrete blocks; solid stone or stone veneer; stucco; wood frame; plywood; plaster board, insulating board, hard board, tile board; wood, metal, or wire lath; plaster; insulation (boards, blanket or batts, dry fill, aluminum, or steel); wood paneling; ceramic tile; glass blocks.
Also: Sheathing, building paper, caulking, fire stopping, soundproofing, treated lumber, waterproofing.

ROOF

Asbestos, asphalt, or wood shingles; copper; slate; tile; insulation.
Also: Down spouts; flashing; gutters.

FLOORS

Maple, oak, white pine, yellow pine, etc.; brick; concrete; glazed tile; terrazzo; linoleum; pressed wood.
Also: Subfloors; soundproofing; finishes.

WINDOWS

Double-hung; metal or wood casement; storm; screens.
Also: Shades; Venetian blinds; weather stripping.

DOORS

Wood; front entrance; French; garage, glass; screens; sliding; double-acting; basement; storm.
Also: Flashing; weather stripping.

TRIM

Wood; metal; composition.
Also: Molding; finishes.

STAIRS

Treads and risers; balusters; handrails; moldings.
Also: Disappearing attic stairs; cellar stairs; outside steps; storm steps; finishes.

CHIMNEY

Brick; poured concrete or concrete blocks;

stone; flues; fireplaces.
Also: Caps; chimney pots; fireplace mantel, hood, and accessories.

HEATING

Steam, hot air, hot water; coke, coal, gas, oil; radiators or registers; air conditioning; humidifier.
Also: Coal chute; automatic controls; thermostats.

PLUMBING

Brass, copper, wrought-iron, galvanized, lead pipes; bathroom, kitchen, and laundry fixtures; water heater.
Also: Garden hose cock; pantry sink; darkroom sink.

KITCHEN

Cabinets; range; refrigerator; sink; dish washer; broom closet.

LAUNDRY

Tubs; washing machine; ironing board; ironer.
Also: Clothes chute; drying cabinet.

HARDWARE

Door and window; cabinet and closet; screen.
Also: Garage door; letter box; foot scraper; milk box.

FINISHES

Paints—oil, water, cement, rubber, enamel, lacquer, stains, varnishes, shellac; wall paper; wall fabrics; wall linoleum.

ELECTRICAL

Lighting fixtures; convenience outlets; refrigerator; water heater; range; sewing machine; dish washer; vacuum cleaner; ironer.
Also: Built-in aerial; burglar alarm; clock outlets; closet hinge switches; doorbells; door chimes; fans; exhaust fan; attic fan; floor polisher; illuminated house numbers; mail-box signal; pilot lights; radiant heaters; range outlet; telephone outlets; thermostat.

GAS

Refrigerator; range; water heater.

MISCELLANEOUS

Incinerator; China closet; bookcases; package receiver; garbage disposer; flower boxes; trellises; fences.

Rules

**\$1000
CONTEST**

THE object of this competition is to encourage readers to plan a house that will best fit their own needs and income, and be suitable for economical construction in their own locality.

Each entry should consist of:

- (1) Floor plans or sketches showing the layout and dimensions of the rooms.
- (2) A sketch or other representation of at least the front view or elevation of the house; and also one or more of the other elevations, if desired.
- (3) A brief description of the house and the materials of which it is to be constructed, including sufficient information about the finishing and equipment so that the judges can visualize it clearly.
- (4) A statement as to the size of the family and the income group for which the house is intended.
- (5) A statement that the design is original.

The drawings should be on good quality paper so as to withstand handling, and may be either in ink or pencil. The accompanying description should be typewritten if possible. The sheets *must not be rolled*.

Only one entry can be made by each person, and no entries will be returned. The prize-winning designs will become the property of this magazine to be used in any way desired.

The competition will be judged by a committee of architects and editors of **POPULAR SCIENCE MONTHLY**. The decision of the judges will be final. In case of ties, duplicate prizes will be awarded to the tying contestants. The contest is open to all except professional architects and employees of Popular Science Publishing Co., Inc., and their families.

The contest closes April 15, 1941, and entries must be mailed fully prepaid and in an envelope or flat package (not rolled) on or before that date. Address the House Planning Contest Editor, **POPULAR SCIENCE MONTHLY**, 353 Fourth Avenue, New York City. Please be sure to write your name and address clearly on each sheet of your entry.

notes you would prepare if you were going to have a consultation with an architect and wished to give him the clearest possible description of your own ideas for the house. Architects themselves are barred from competition. All that counts is the quality of the ideas—that is, the suitability and general excellence of the plans.

In addition to the floor plans, some sort of sketch or other representation should be submitted to give the judges an idea of the appearance of the front view or elevation, and of the other elevations too, if you wish. It is, in fact, well to make such sketches because they enable you to check up on the relationship between the interior and the exterior designs. You might, for example, have excellent first-floor and second-floor plans, but an extremely unsatisfactory exterior appearance due to the spacing of the windows.

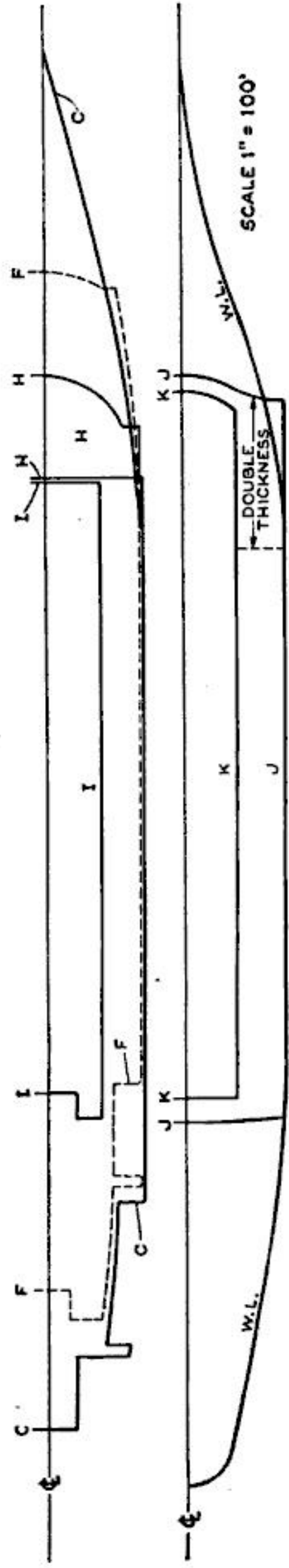
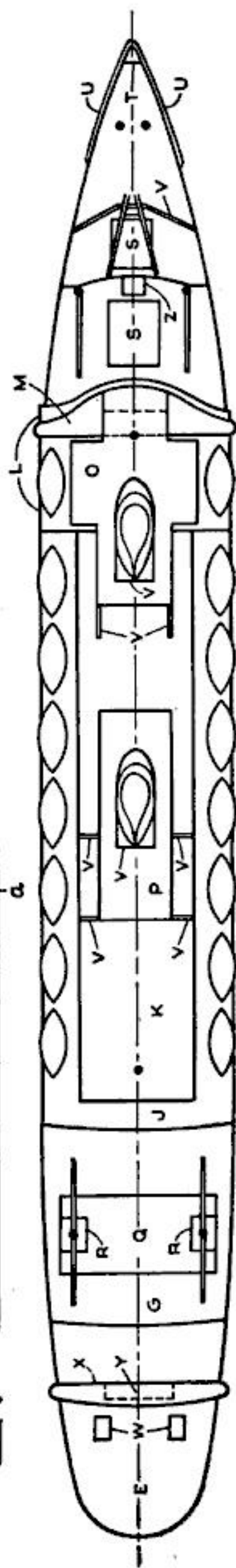
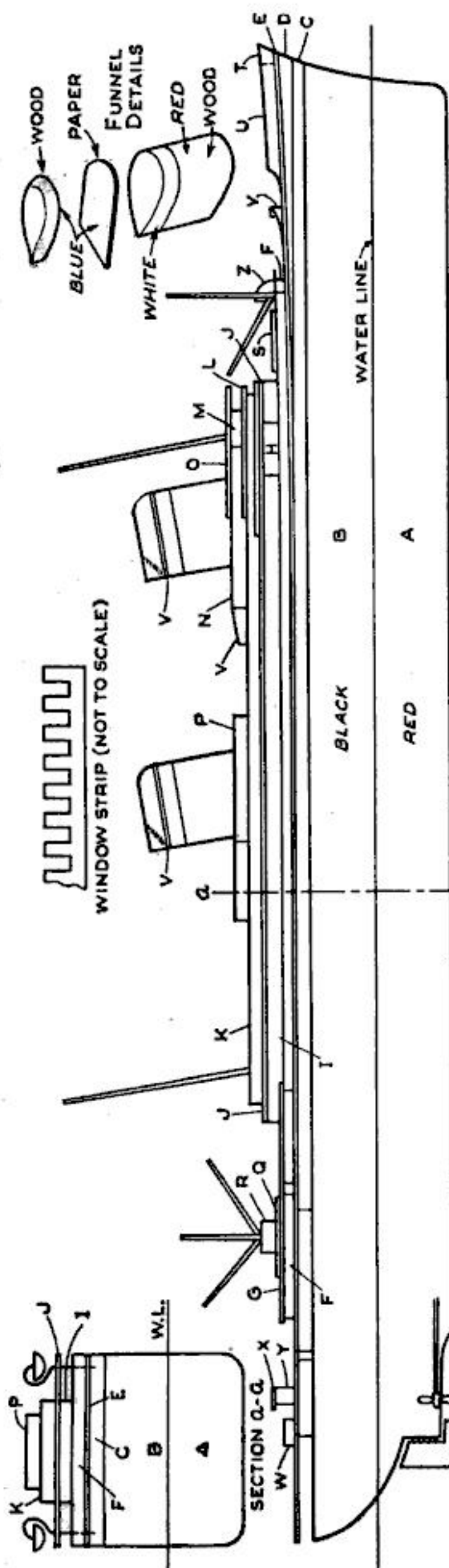
To supplement these sketches or drawings, we ask you to describe the house briefly. Here again, the information is purely to guide the judges in reaching a decision, and it does not have to be dressed up in any way. Simply give the dimensions of the house, the size of the plot for which it was designed, and what you estimate the plot and the building would cost in your own locality. Mention the size of the family and the income group for which the house is intended.

It is also necessary to list briefly the kinds of materials and equipment you have in mind. For example, tell what the foundation and the exterior, including the roof, is to be constructed of; then specify the materials used inside, and supplement this by making a list, room by room, to show what special materials, finishes, and equipment you consider most desirable. Give the judges a sufficiently complete list so that they will know just about how you intend the living room to look, what your kitchen would be like, and so on.

To this information should be added a paragraph or two summarizing the advantages of your plan. In other words, tell the judges just why you think your plan deserves a prize. Also, please append a signed statement to the effect that the plans and specifications are original and have not been prepared from the published or private plans of any other person.

So that you will not be likely to overlook any item of importance, we have prepared check list of materials and equipment, although this makes no pretense at being complete.

In addition, we have shown some conventional methods of indicating doors, windows, and the like. These represent a sort of handy shorthand used in the building trades. You will find it convenient to make use of them in sketching your plans.



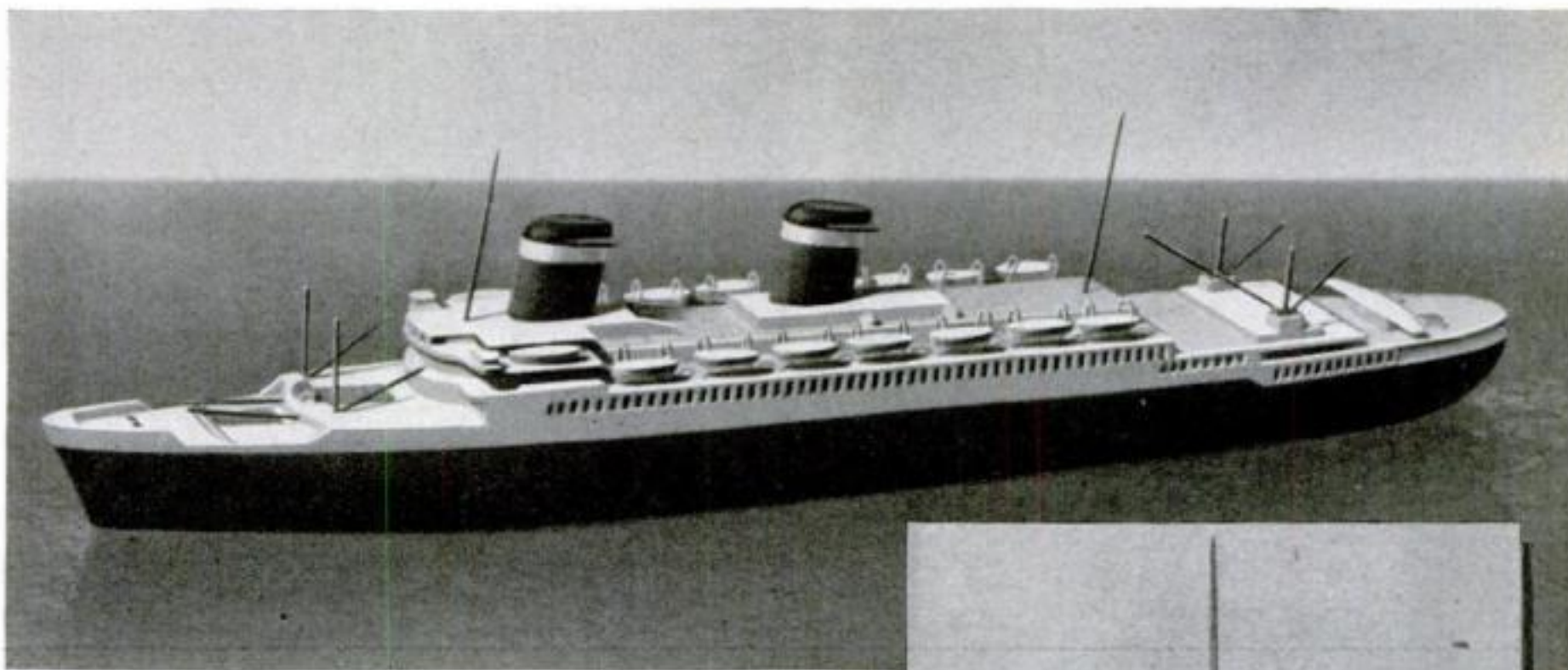
SCALE 1" = 100'



WARTIME LETTERING
ON SIDES (OPTIONAL)



A MINIATURE MODEL DESIGNED BY THEODORE GOMMI



This is a water-line model $7\frac{1}{4}$ " long. The drawings, left, are full size; the bow view at right is enlarged

LARGEST and speediest passenger vessel ever built in an American shipyard is the new S. S. *America*. She is also one of the most distinctive and graceful ships.

We are indebted to the owners, the United States Lines, for her plans. The *America* is 723' long, and since our model is constructed to the 1"-100' scale, it is $7\frac{1}{4}$ " long. The shape of the various thin layers is shown in the half-breadth profiles under the plan. If a full hull model is desired, A and B can consist of one piece of wood.

For the lifeboats, sandpaper the corners of a $\frac{5}{16}$ " by $\frac{1}{8}$ " stick to shape, mark into $\frac{1}{16}$ " spaces, and cut as if slicing bread. Allow sufficient length of wire for the davits so that the ends can be inserted into holes drilled in F' after passing through J. Insert the davits before fastening the window strip. A very fine (No. 80) drill is indispensable. Glue each boat (except the forward pair) to two davits.

The window strip, although it may be omitted, greatly enhances the model. An excellent tool for cutting it is a single-edge razor blade, broken so that only about $\frac{1}{16}$ " cutting surface remains at one end.

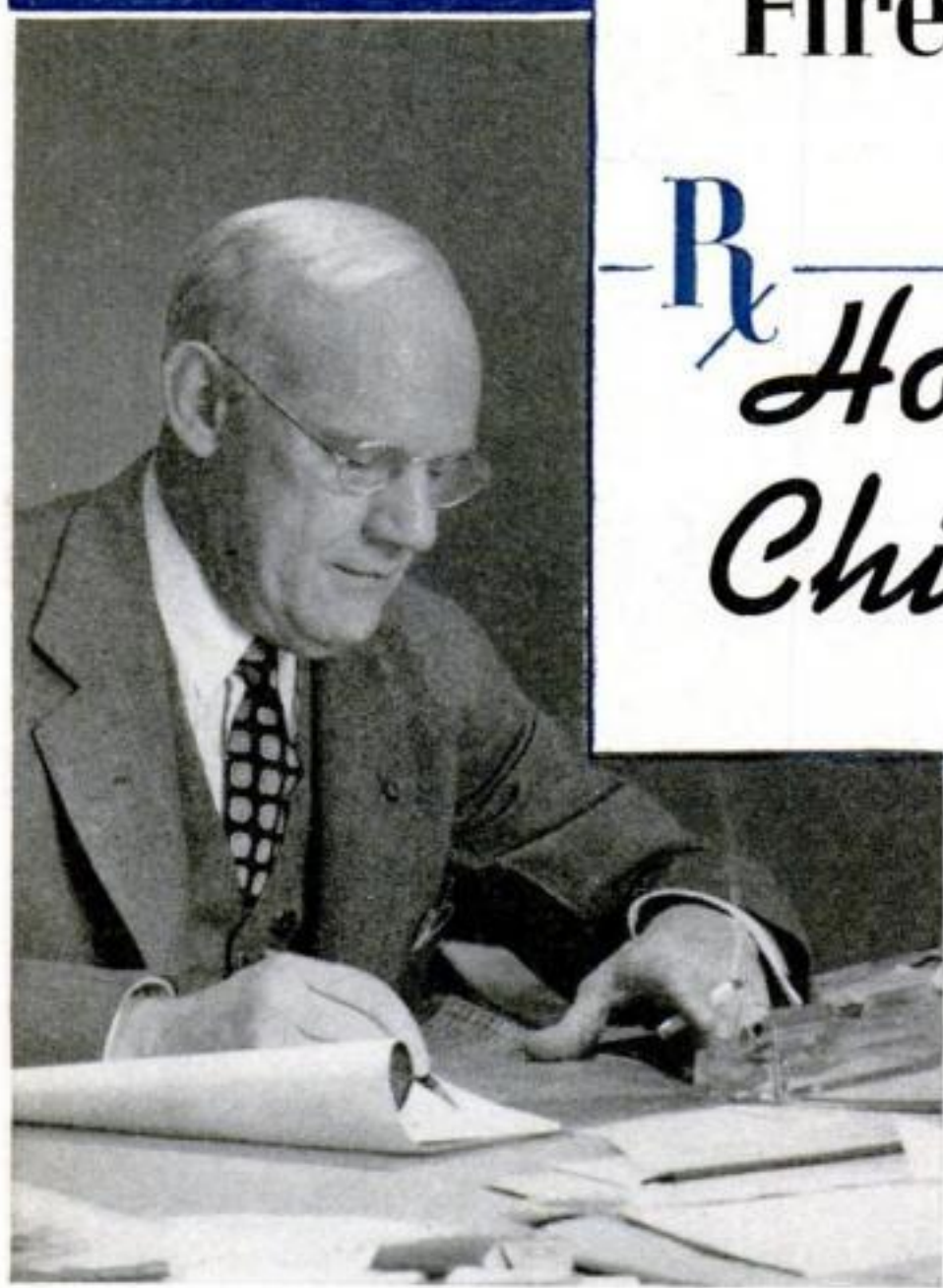
The funnels were originally short, but had to be lengthened 15'. In the model, they are made in three sections. Masts, derricks, and other details are made from wire and pins. All should be painted buff before they are attached to the superstructure. The sides of the hull are red and black; superstructure and decks, white.

MATERIALS—White pine, basswood, or balsa:
For A, 1 pc. $\frac{3}{8}$ " by 1" by $7\frac{1}{2}$ ".
For B, 1 pc. $\frac{5}{16}$ " by 1" by $7\frac{1}{2}$ ".
For C, D, F, I, H, K, M, N, P, R, T, W, Y, Z, 4 pc. $\frac{1}{16}$ " by 1" by $7\frac{1}{2}$ ".
For funnels (base only), 1 pc. $\frac{3}{16}$ " by 1" by $2\frac{1}{2}$ ".



The New S. S. AMERICA

For E, 1 pc. $\frac{1}{32}$ " by 1" by $7\frac{1}{2}$ ".
For lifeboats, 1 pc. $\frac{5}{16}$ " by $\frac{1}{8}$ " by 8".
Miscellaneous: For G, J, L, O, Q, S, U, V, X, and the window strips and rudder, 2 pc. thin card or Bristol board 1" by 8".
For masts, 2 thin needles $1\frac{1}{4}$ " long. For derrick posts and screws (propellers), 6 small pins $\frac{3}{4}$ " long. For booms, davits, etc., about 24" of thin, stiff wire. Black, flat white, buff, red, and blue paint.



Frederic N. Whitley uses draft formulas based on research by four generations of Whitleys. He keeps these trade secrets in a steel vault when not in use

Fireplace Doctor Tells

Rx How to Cure Chimney Ills

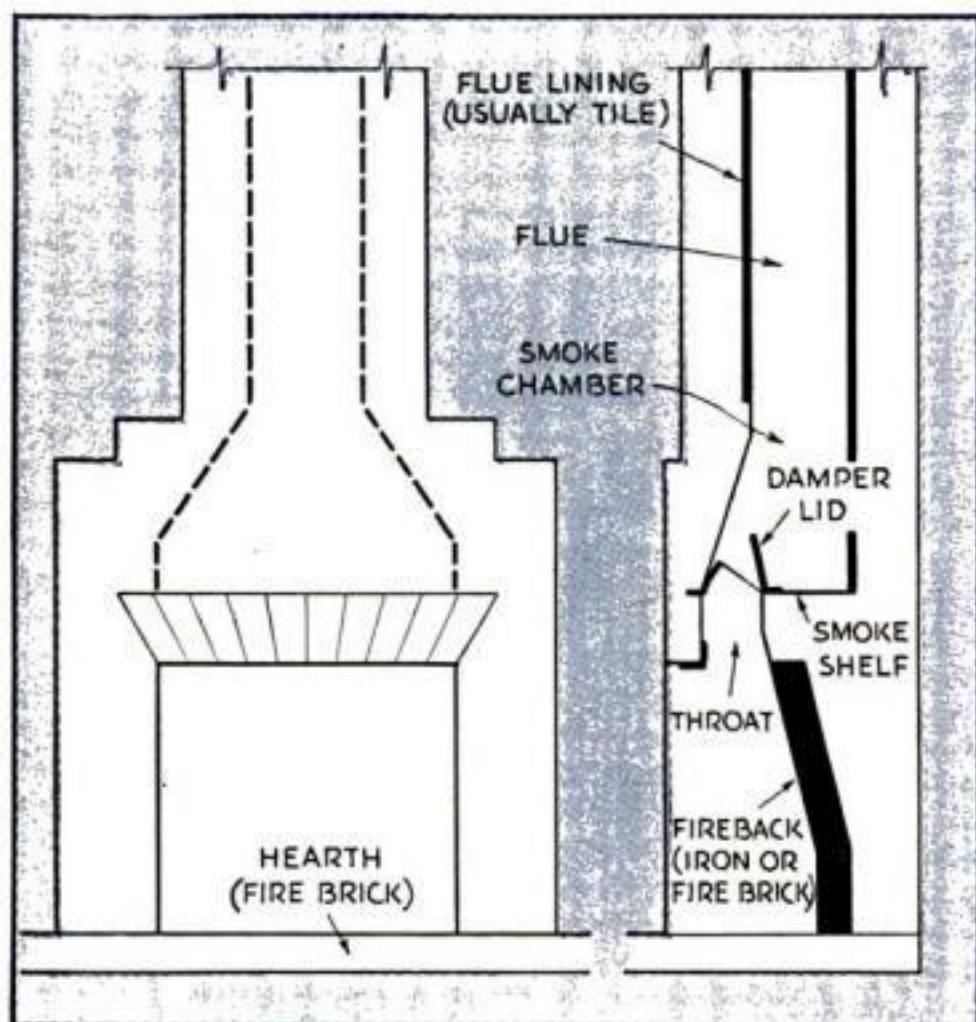
By SIGMUND SAMETH

WHEN a New York socialite opened his suburban home recently with a house-warming party, all went well until a chilly guest suggested that the big fireplace in the main living room ought to be tried out. Smoke poured into the room as soon as the match was applied.

Ladies in ermine wraps edged toward the door with their escorts and made hasty apologies about leaving. A few hardy souls stuck it out. One of them, between sputterings and coughs, suggested that the damper might be shut. The host investigated and found that the damper was wide open, yet acrid wood smoke continued to curl out. Finally the butler was called in to drench the logs, and the remaining company sat down to a cheerless evening at the card tables. The next morning Frederic N. Whitley, of Brooklyn, N. Y., the fireplace doctor, found he had a new client.

Four generations of Whitleys have cured fireplace ills, beginning with great granddad, James Whitley, who founded the firm in 1872. The present head of the firm uses no complicated methods for diagnosing chimney ills. In fact, his most useful instrument is a lighted cigarette.

First, a fire is made to duplicate the actual conditions under which the fireplace will be operated. The cigarette is held about 4" in front of the fire-



Here is a typical fireplace with a cross-sectional view showing the essential parts. To have the flue centered directly above the fireplace is an ideal arrangement

place opening and moved slowly, following a checkerboard pattern, until it has covered the entire area of the opening. At certain spots the smoke is sucked violently into the opening by the draft. At other places will be found dead-air pockets where the cigarette smoke appears sluggish or is even ejected back into the room. These are clues, and correction of the internal architecture of the fireplace will eliminate the dead-air pockets.

Sometimes it is a simple job such as knocking out a few projecting bricks which deflect the air currents. Or it may be necessary to block up the top portion of an arch in the fireplace so that a stronger draft will be created in the remaining opening. Less frequently, an alteration in the size of the chimney flue is needed.

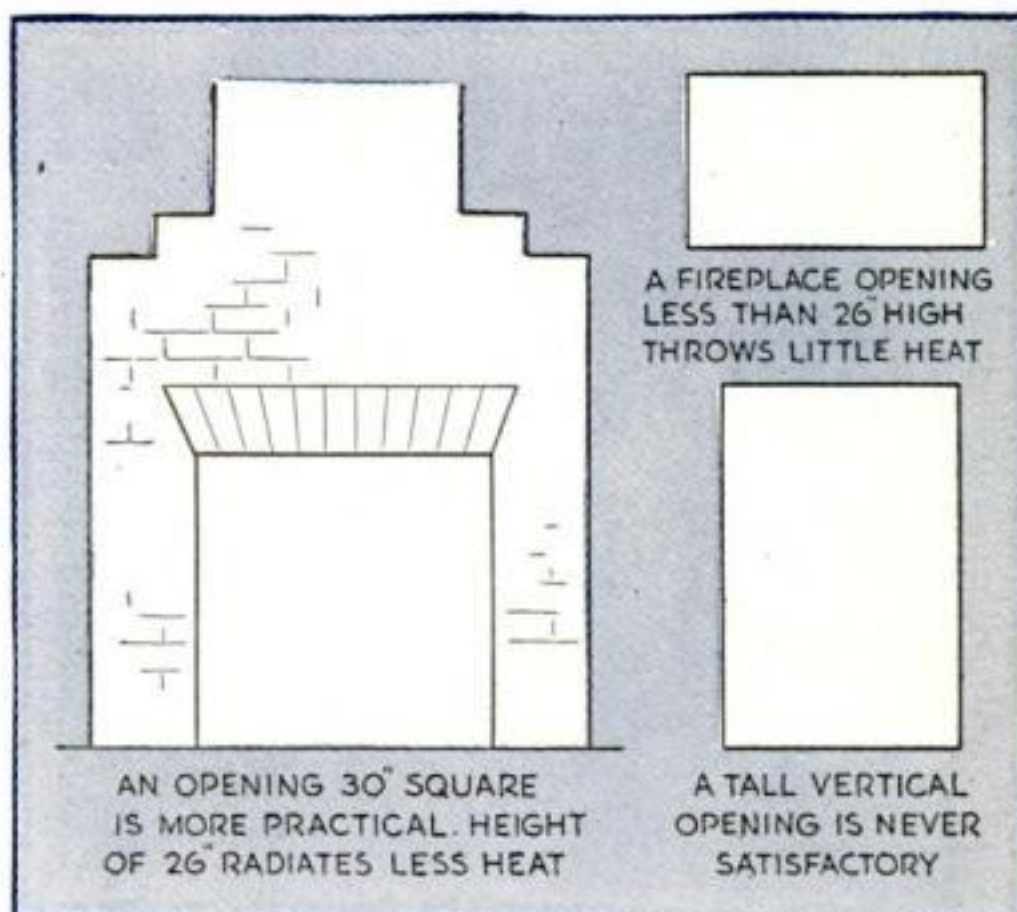
"Make your flues oversize rather than too small," Mr. Whitley warns anyone who intends to build a fireplace. "Large flues can always be compensated for by closing down the damper slightly, but there is no way to compensate for a small flue except to make the fireplace opening smaller."

Here's a convenient rule of thumb to guide you in flue construction: *Have the ratio between flue area (cross-sectional) and fireplace opening at least 1:12.* This means that every square foot of fireplace opening should have at least 12

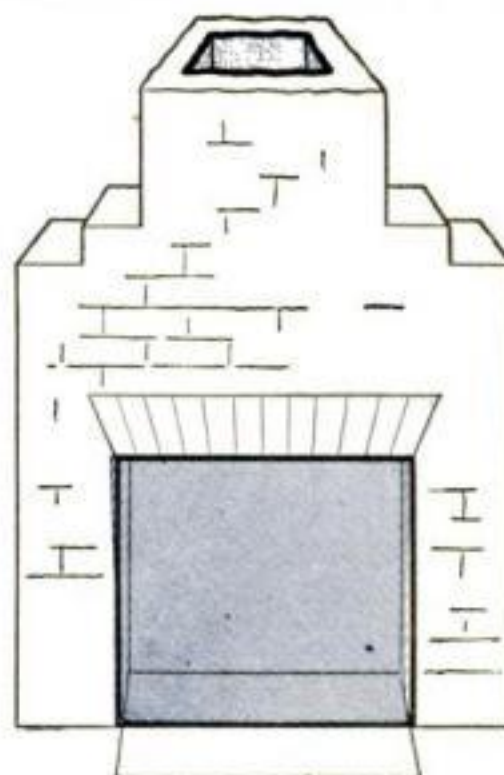
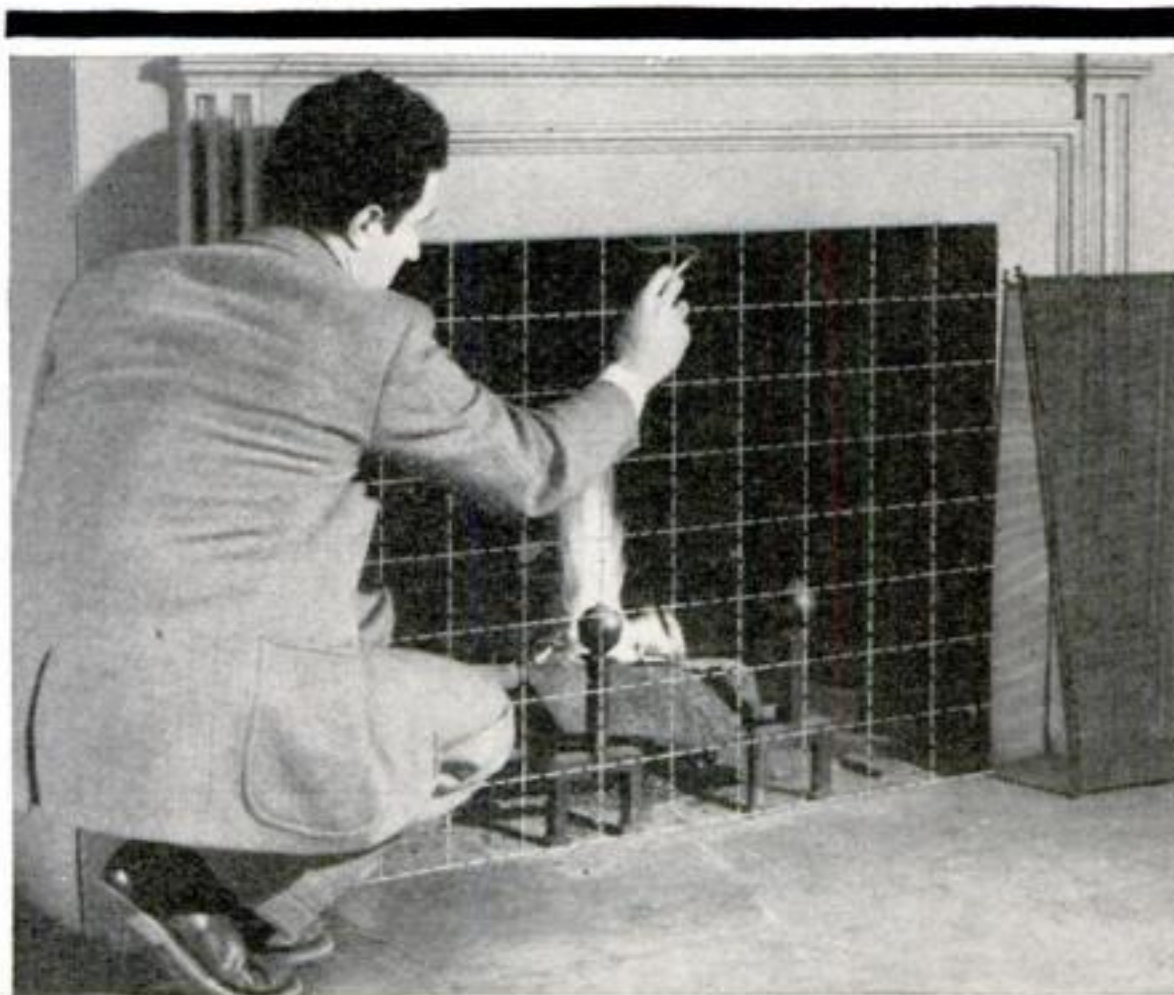
square inches of flue cross-section area.

Actually, the problem of flue ratio is not as simple as it sounds. The type of flue lining used, for example, must be considered. An unlined flue with a roughened inner surface will offer friction to the smoke and set up turbulence. For a flue of this type the ratio should be 1:10.

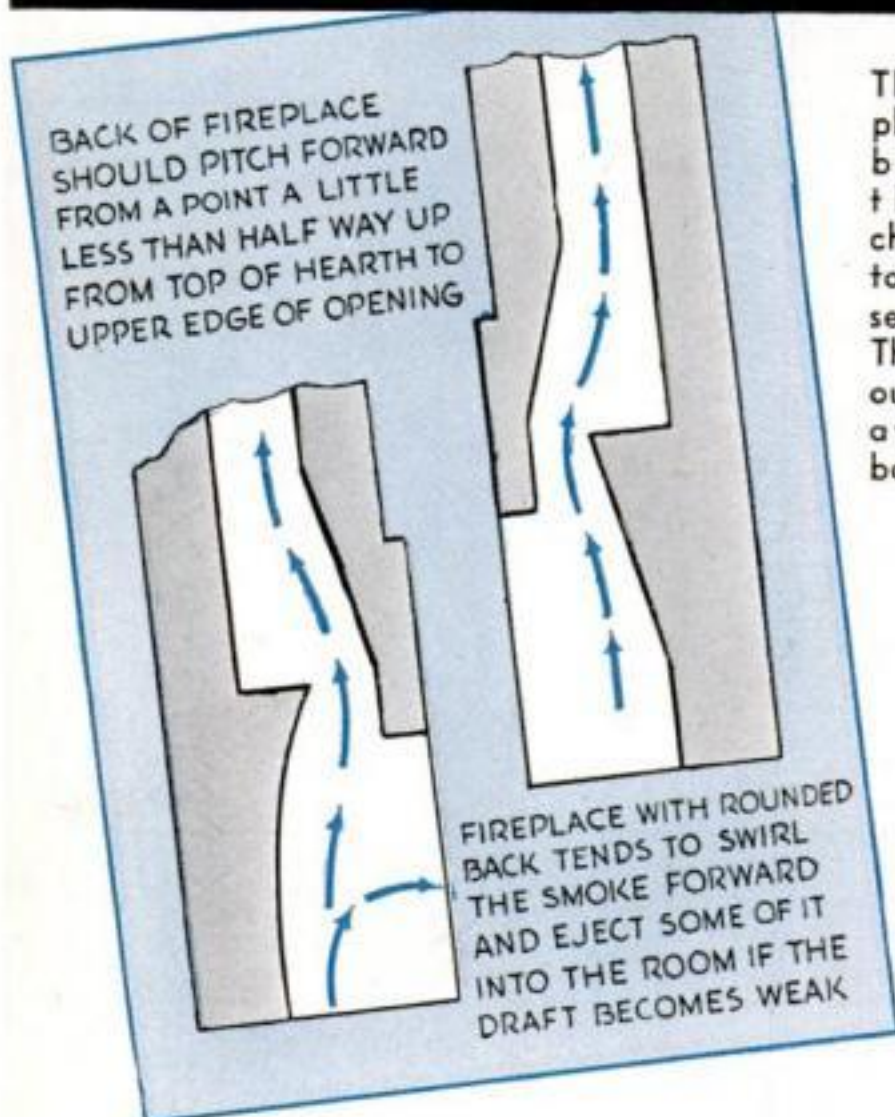
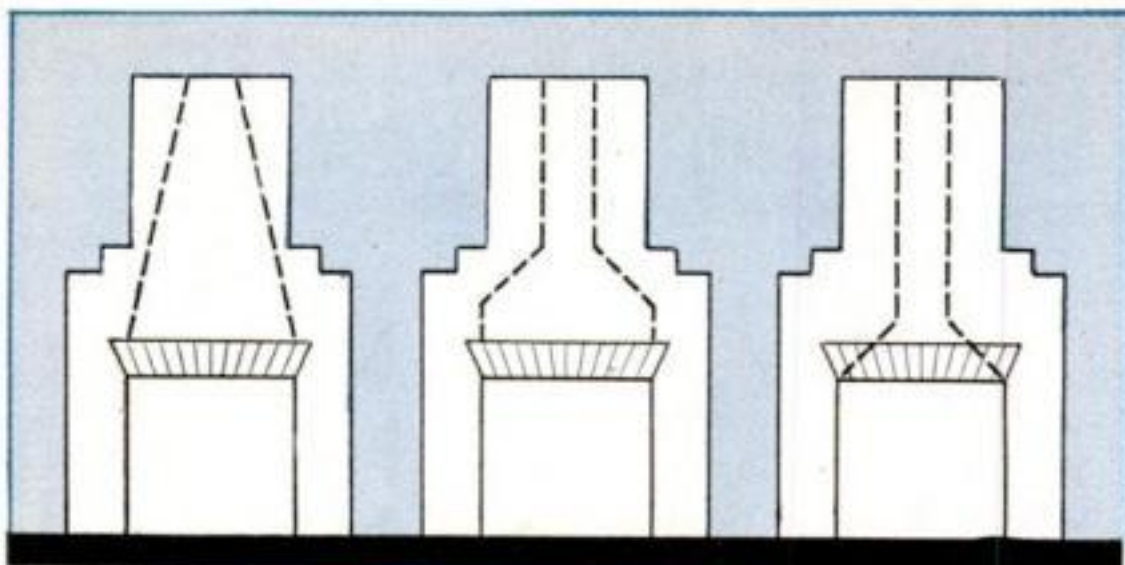
The shape of the flue is another factor that upsets all theoretical calculations, according to Mr. Whitley. Certain flues, such as those with a narrow oblong cross section, are very inefficient. One that was tested proved only as effective as a flue with



Below, by moving a lighted cigarette before a fireplace in checkerboard fashion, draft faults are found



The correct flue ratio is most important. Measure the cross-section area of the flue at its smallest point. This must not be less than one twelfth the area of the fireplace opening itself



The first fireplace above is bad because the smoke chamber tapers too slowly. The second is ideal. The third spills out smoke. Left, avoid round-back fireplaces

with ropes. Pick a rainy day to do the job, or wet the chimney down with an insect sprayer full of water. You'll find that the task of removing soot is far less untidy than on a dry day.

One of the rules that guides Mr. Whitley is this: "A flue is as effective as the area afforded at its smallest point." A poorly

vacated. Such screens gum up with soot in a few days. It's much simpler to close the damper when you shut your house up for a few weeks.

Soot is another enemy of the fireplace owner, for the deposits are often 2" thick and cut down flue area considerably. These are hard to remove, too, because they are bound to the flue wall with a tough, gummy creosote.

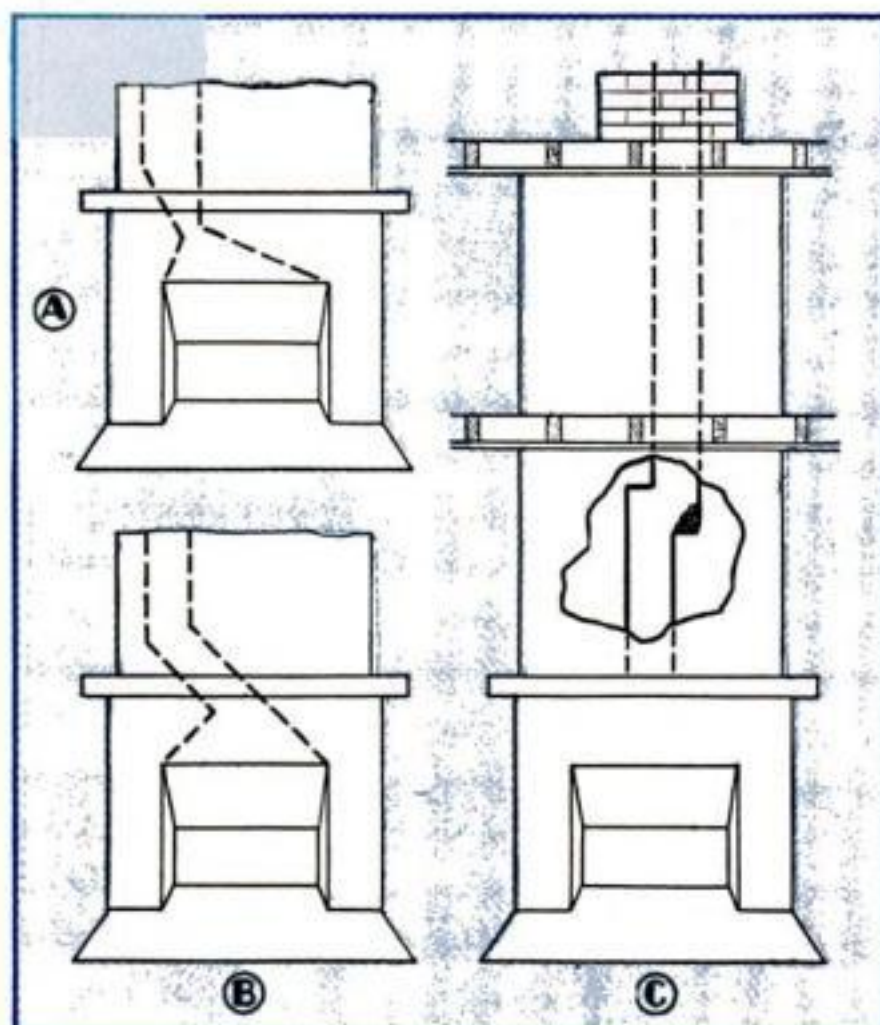
If you must be your own chimney sweep, build a roaring fire with newspapers in the fireplace. Keep it blazing with the damper open for about fifteen minutes to burn out the stubborn gummy layer. The fine dry soot that remains can be swept out of the flue by pulling a wire flue brush or a straw-filled burlap bag up and down through the chimney

a circular cross section of half the area.

Many times when fireplace openings and flue proportions are found to be correct, the cause of smoking lies in some obstruction, such as mortar droppings. For this reason, sharp bends in flues should be avoided. If you are building a house with a fireplace, ask the architect to indicate the flues by dotted lines on the plans. It is wise to leave openings in the brickwork before furring and plastering so that mortar droppings may be cleaned out. Birds' nests, especially after the house has been closed for some time, may block the opening, or a brick from the chimney itself may tumble off in a high wind.

If your chimney and flue are in a straight line, you can look up the fireplace opening with the aid of a mirror held at a 45-deg. angle. Where bends exist in the flue, careful probing with a long stick or weighted line will soon tell you where the trouble is.

Don't, as one home owner did, cover the chimney opening with fine screen wire to keep out rodents while the house was



A fireplace with an abrupt offset and pinched flue as at A is so bad it must be rebuilt. If an offset cannot be avoided, the smoke chamber should taper evenly until it is the proper flue area, as at B. An offset as at C is all wrong

constructed damper which does not open up to the full width of the fireplace throat may be forming the constriction that causes smoke to roll out of the corners, or a narrow chimney pot may act as a bottleneck on an otherwise satisfactory flue.

All of us have heard the expression "as solid as a brick wall," yet brickwork can be far from solid when it comes to holding in flue gases. This is especially true of old brickwork where the mortar has begun to disintegrate. To test for this type of draft loss, a fire of tar paper is built. When black smoke is rolling out the chimney, the opening is smothered with a wet blanket or a piece of sheet iron. The cracks and crevices will now be seen as smoke seeps from them. Repointing the brick and buttering on fresh cement with a liberal hand will often correct the condition.

The profession of chimney doctoring brings Mr. Whitley strange jobs. One of the most puzzling was a small fireplace in a Long Island country home. It refused to draw, yet the flue was the proper size and shape, and there were no construction faults in the fire box. Mr. Whitley poked his head into the fireplace opening and looked up the flue, which seemed to be open all the way up. There were no obstructions in sight, and the flue looked as clean as a whistle. Finally he climbed to the roof top and dropped a piece of brick inside the chimney. There was a tinkle of glass as it crashed through a pane of glass that had been cemented into the chimney halfway down. Incredible as it seemed, a dissatisfied workman had been responsible for the clever bit of sabotage!

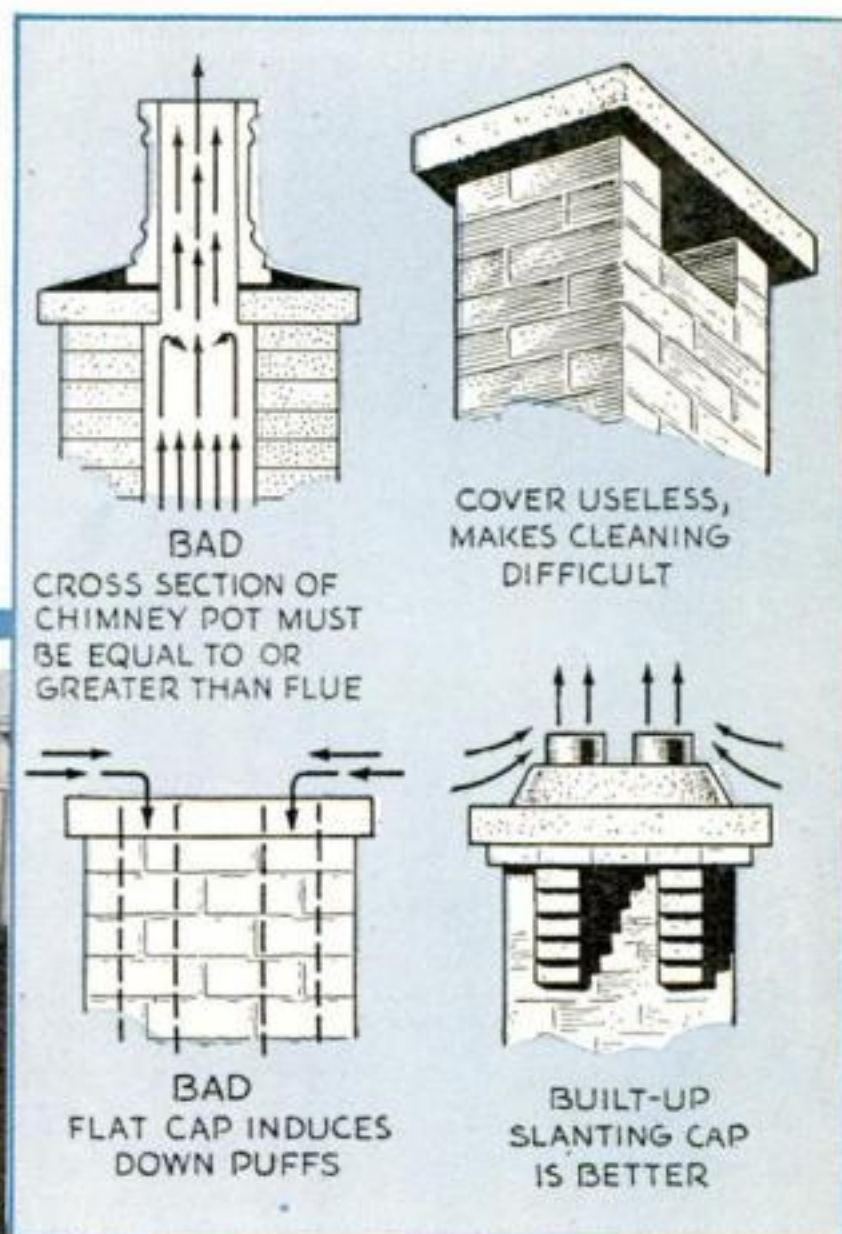
Smoke chambers in fireplaces are a

necessity, and don't let anybody tell you otherwise. If the fireplace has no smoke chamber, your room will soon get to be one. The function of the chamber is to act as an emergency container of smoke and hold it in case a gust of wind cuts off the draft momentarily. A good size for the smoke chamber is one half the volume of the fire box.

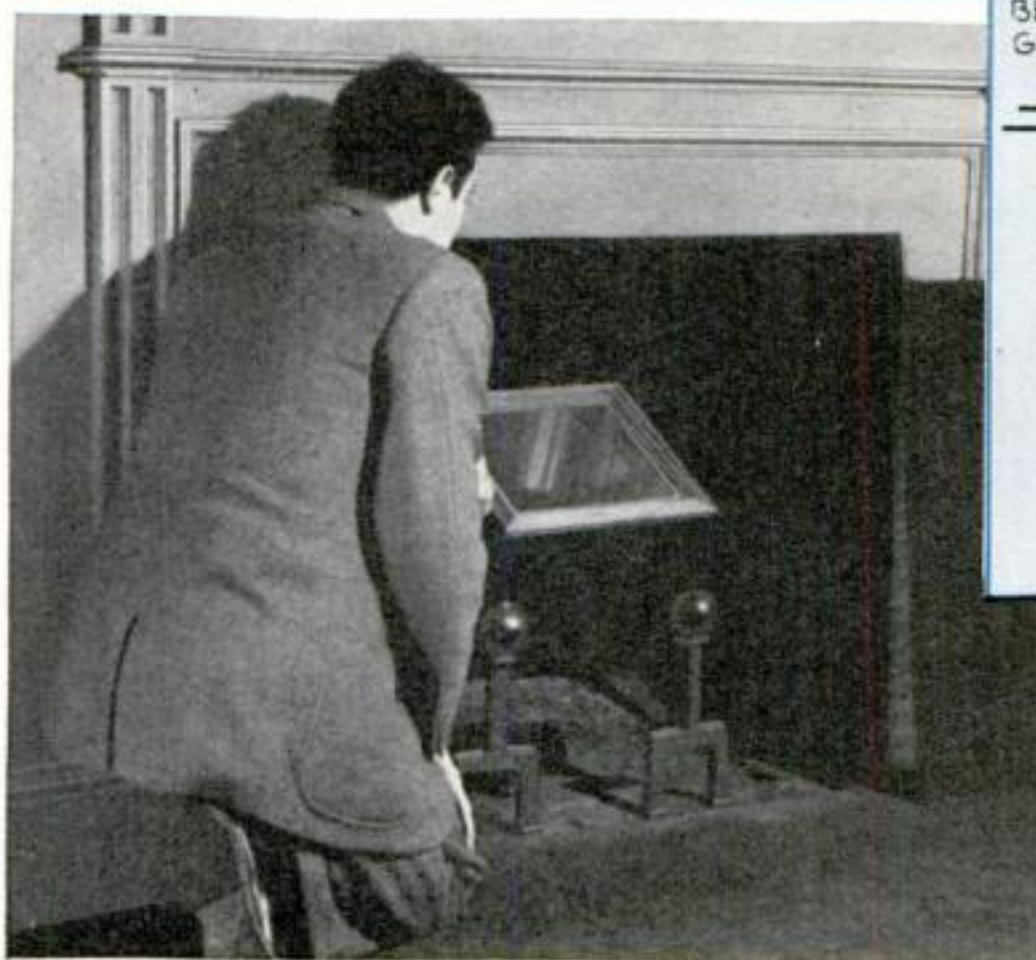
Sometimes the smoke chamber is called the "throat" although, properly speaking, the throat is the lower end of the chamber only. It is the most critical part of the fireplace, and the feature on which most amateur fireplace builders go wrong.

If you are contemplating building a fireplace, watch out for these points: The throat should be the full width of the fireplace to keep smoke from rolling out the corners. Its area must be at least as great as the cross-sectional area of the flue above the smoke chamber. It won't hurt to exceed the minimum width by a couple of inches.

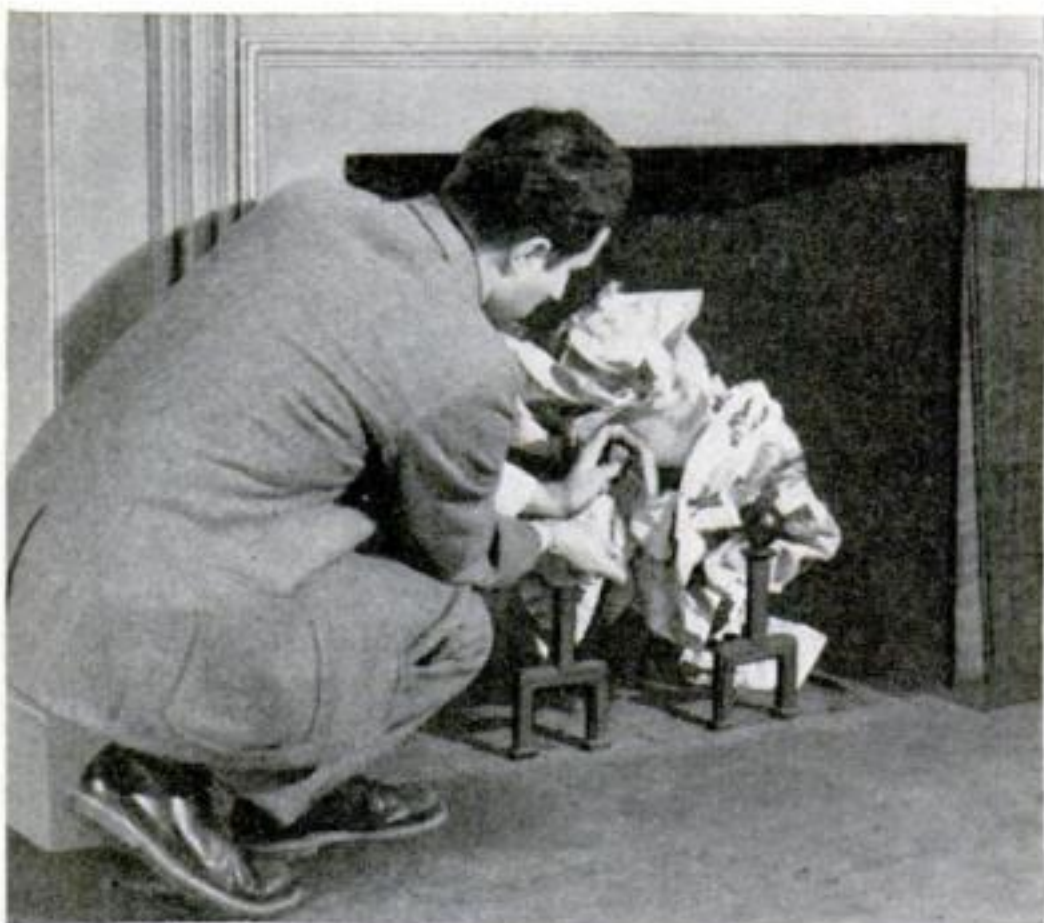
Don't build a fireplace without a damper or you may regret it. Under certain conditions the damper is not needed, but you will



Three poor chimney tops and a good design in which the flue-lining tiles project 6" above the chimney cap, with cement packed around them. Left, inspecting flue with a mirror



Disintegrated mortar joints are never air-tight and often cause bad draft losses. Soot deposits, as at far right, considerably reduce flue area. They may be burned out with a newspaper fire (below). The dry dust is then removed with a flue brush or straw-filled burlap bag



appreciate its convenience in regulating the fire and also in burning different kinds of wood. Pine, for example, needs as wide a damper opening as possible, because it burns quickly with a fierce draft. Oak, which burns slowly, requires a smaller opening.

In planning a home fireplace there are other features to consider. Take the simple matter of fireplace depth. Experience shows that a medium-depth fireplace—about 18" from front to back—is best for average use.

A fireplace ought never to be less than 26" high, and 30" is even better, otherwise it is inconvenient to tend and throws most of its heat too low down in the room. In planning the width of the fire box, take into account the type of wood available. If you can buy cordwood, make your firebox 30" wide and it will take a 24" billet of half-sawed cordwood nicely. Another convenience is to have the hearth on *floor level*, not above it. Room dust and litter can then be swept into the fireplace directly instead

of by brushing into a dustpan.

Before you build a fireplace, Mr. Whitley advises, get the plans and sketches on paper and have them approved by a reliable architect or fireplace consultant, especially if you want to embody new and convenient features such as a supplementary air supply for the room to replace the air sent up the flue by the draft created by the fire.

There's even an art to starting and tending a fire. First scoop a hole in the ashes between the andirons and place your tinder in position. This may be a crumpled newspaper, a piece of building brick soaked in kerosene, or fatty pine kindling.

Wood should be laid on the andirons loosely so that ample air will reach the burning surfaces. The first sticks ought to be small ones, of course. You should keep wood of this type in a corner of the wood box just for fire starting.

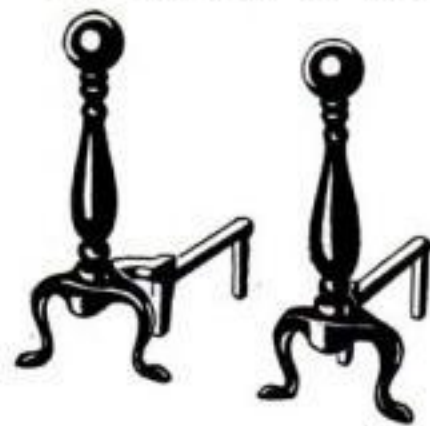
Hold on! Don't strike that match yet.

Is the door open? If it isn't, open it. When you apply the match to the tinder,



It is easier to place logs on squatty andirons like those shown above

Tall andirons, even if patrician looking, are unhandy to use



you will want a big draft of heated air to rise through the flue. If there is no opening through which fresh air can flow into the room, a partial vacuum will be caused and the fireplace will smoke instead of drawing. So make sure there is a source of fresh air even if you have to open the window an inch at the bottom to get the fire started.

Now we're ready for the match, and one match ought to do the trick if the tinder has been properly prepared and there is enough fast-burning wood above it to catch. Open the damper wide.

One way to start a fire easily is to make a "blower" out of plywood or sheet metal, which blocks off the lower part of the fireplace opening. In the bottom of the blower is a narrow slot that admits a powerful draft of air to compensate for the decreased fireplace opening. With a device of this type, which may be stored behind a door when not in use, the need for clumsy, old-fashioned bellows is eliminated.

When tending a fire, put your wood on a stick at a time. An arm load of fresh wood dumped on a fire will often smother it. Keep a heavy log of slow-burning wood, such as oak, at the back and put the fresh logs on top of it until they catch. The glowing brands and embers should be raked toward the front where all of their heat will be felt in the room. Never put new wood on at the front.

Oak is a dense wood and smolders unless some lighter wood is burned with it. Pine, on the other hand, burns too rapidly for best results and it makes the task of fire

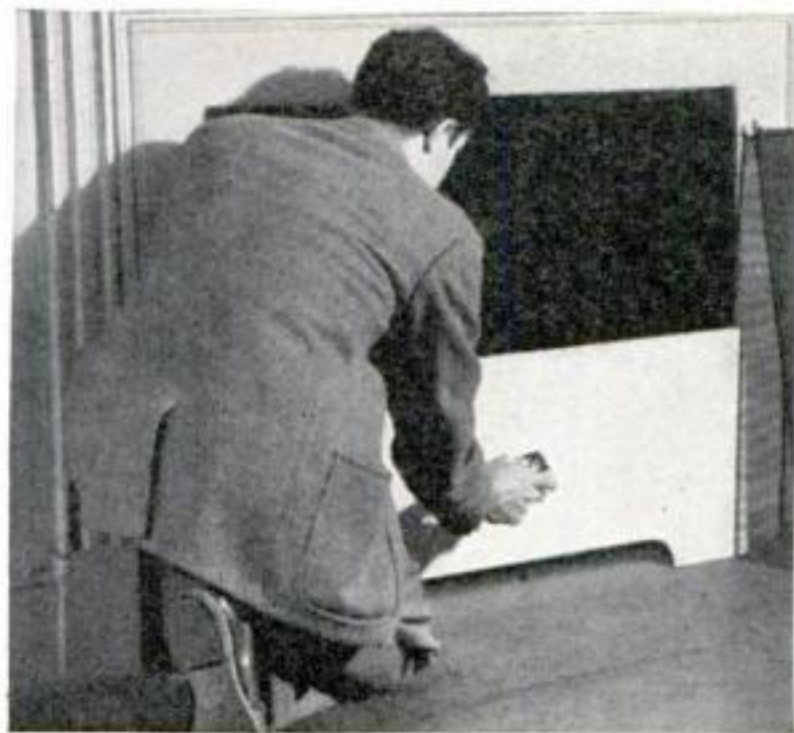
tending a never-ending one. The ideal wood is dry, seasoned hickory, which burns for a long time with a beautiful flame and leaves good coals. Winter-cut wood is less sappy and burns better than summer-cut wood.

Don't make the common mistake of keeping your fireplace spotlessly clean. The bed of ashes accumulated after months of fires forms a most useful feature. When you retire at night, burning brands may be buried in the ashes where they glow all night, supplying heat.

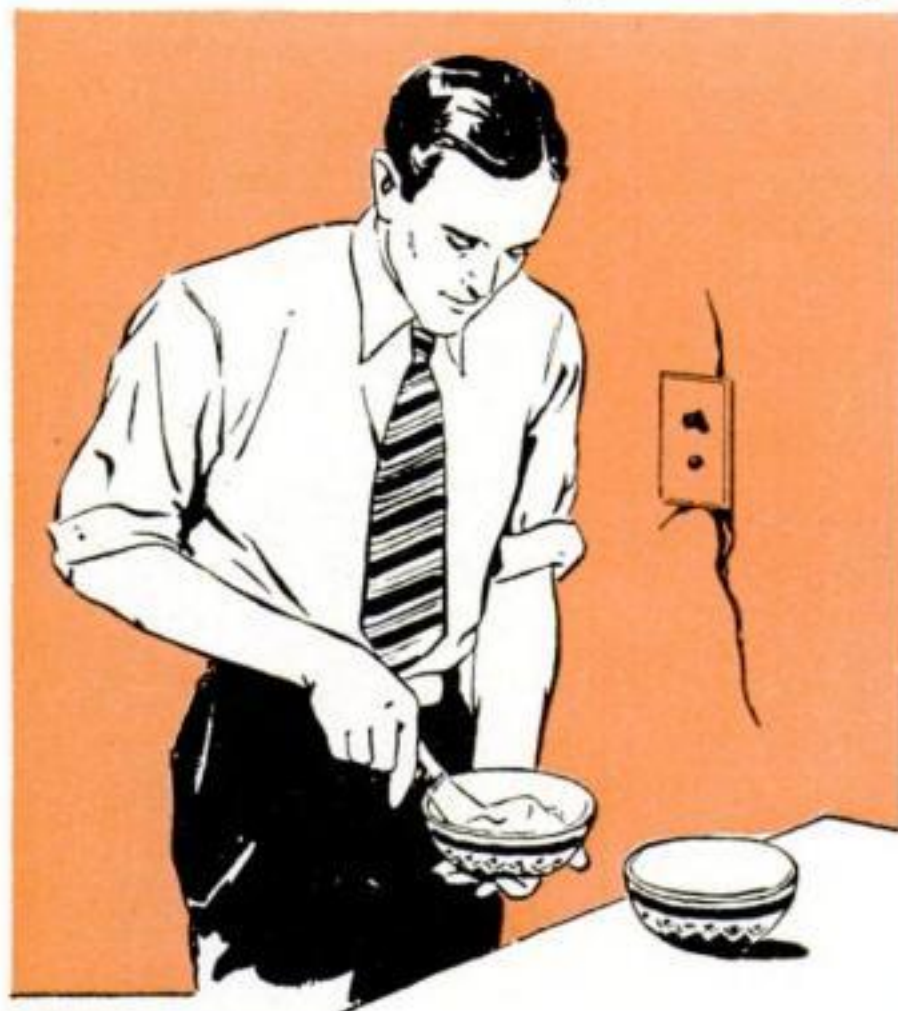
The ashes should reach the level of the andiron crosspieces. Between the andirons a scooped-out hollow will receive hot embers and concentrate the heat so that the fire will burn briskly. When the ashes overflow the hearth, remove some of them until the desired level is maintained.



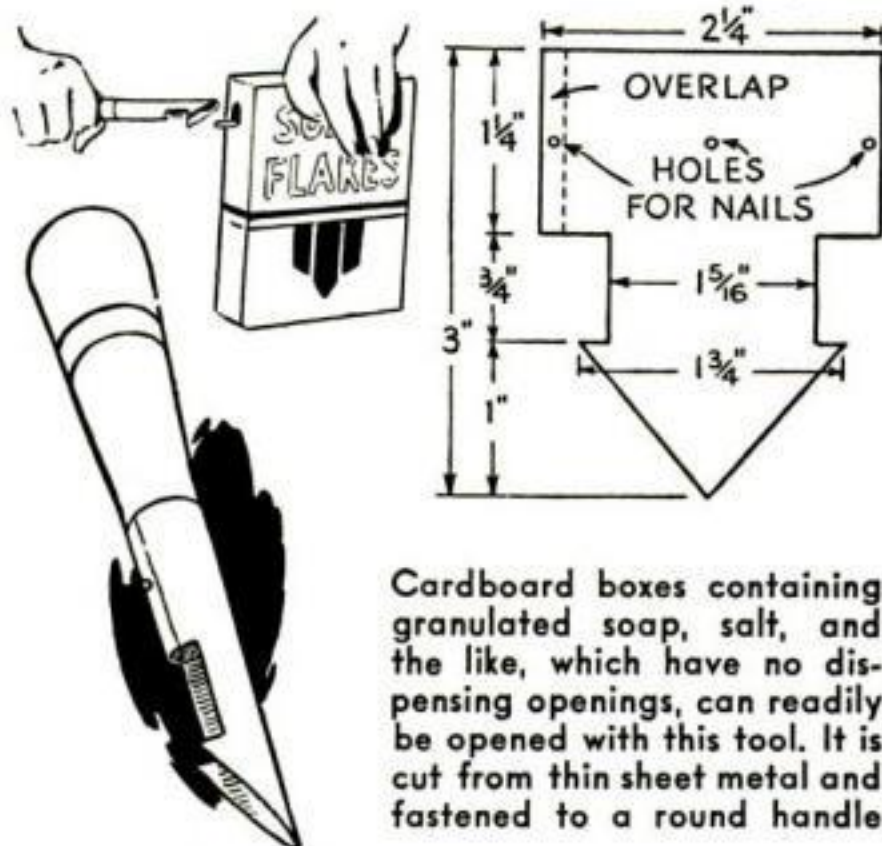
When conditions permit, it is desirable to build a wood box into the wall next to the fireplace, or just outside the wall, so that logs may be put in from the outside without carrying them through the house. Below, left, starting a fire with a draft inducer. At right, don't be too tidy! Let the ashes accumulate



Keeping the Home



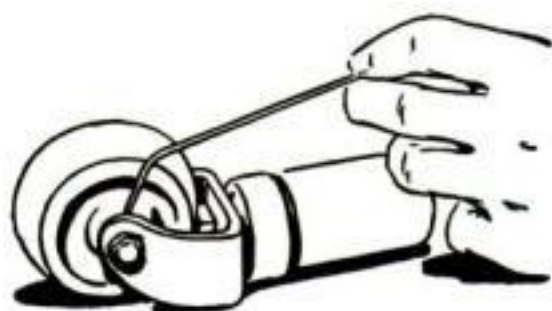
For mixing small quantities of plaster-of-Paris or patching plaster, there's nothing better than the two halves of a large rubber ball. The curved bottom fits in the hand nicely, and any remaining plaster that hardens is removed by squeezing the sides



Cardboard boxes containing granulated soap, salt, and the like, which have no dispensing openings, can readily be opened with this tool. It is cut from thin sheet metal and fastened to a round handle



To remove spots and dirt from luggage and radios covered with "airplane cloth," wipe the soiled surface gently with a clean cloth moistened with lacquer thinner. Apply it sparingly. Then coat surface with clear brushing lacquer



Don't use ordinary machine oil for lubricating rubber-wheel casters; use castor oil instead. Mineral oil causes rubber to soften and swell; castor oil doesn't affect it



In order to locate a particular key easily, drill a new mounting hole. The top of the key will then project above the other keys on the ring and is instantly found



Wrapping your best or little-used dishes in cellulose wrapping tissue will keep them free from dust. The contents may be seen at a glance without unwrapping each package. With care the wrappers may be utilized many times

Shipshape



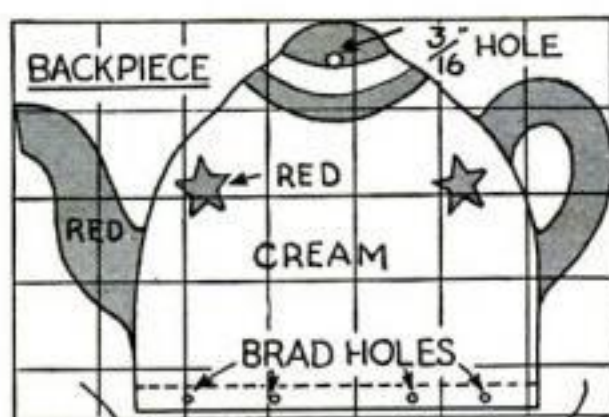
When filtering corrosive chemicals or other liquids that are dangerous and therefore should not come into contact with your hands or clothing, attach a wooden spring clothespin to the edge of the filter funnel and use it as a handle



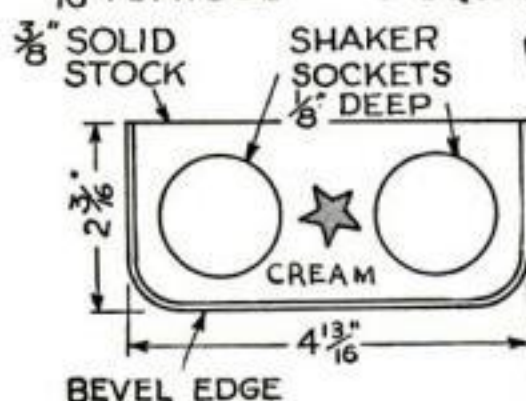
Exposed iron bearings and movable parts in a household scale often become rusty, making the scale erratic and difficult to adjust. This can be cured by removing the base and oiling all moving parts and bearings with light machine oil. Then readjust the weight indicator



Small rubber caps, of the type used under furniture legs, will protect oilcloth and porcelain-top tables from dents and marks if placed under the legs of a vegetable ricer or other similar kitchen utensil



$\frac{3}{16}$ " PLYWOOD 1" SQUARES



The kitchen salt and pepper shakers are within easy reach if this colorful little holder is hung over the range. Paint the holder cream and red, and add a bright decalcomania to the center of the backpiece



A rubber band around the spool will secure the end of a thread



An improvised floor polisher may be made as follows: Wrap a brick in any soft material, pinning the padding in place; then wrap this in a burlap sack. Fold the ends neatly and slip through the clamp of an old mop handle



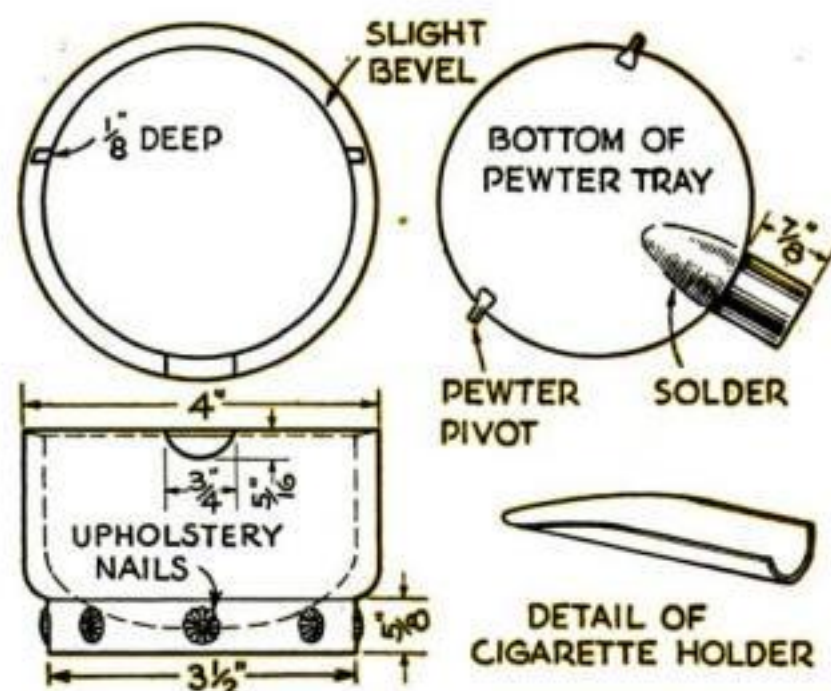
Ash Tray

in birch and pewter



WORKING TIME:
One Evening

Craftsmen, 3 hours
Beginners, 4 hours



DESIGNED by George W. Blow, a New York industrial designer, for the Metropolitan Junior Achievement, this ash tray combines modern simplicity with beauty and utility. The body or ash receptacle is turned from a block of birch or other attractive hardwood. The ash-tray top is a disk cut from 16- or 18-gauge sheet pewter and hammered to a slight depression in the center. The cigarette support, bent from the same material, is soldered into a cut made in one side of the pewter tray.

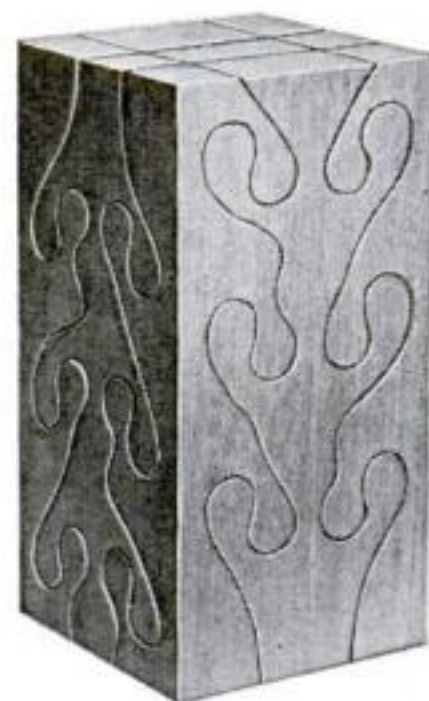
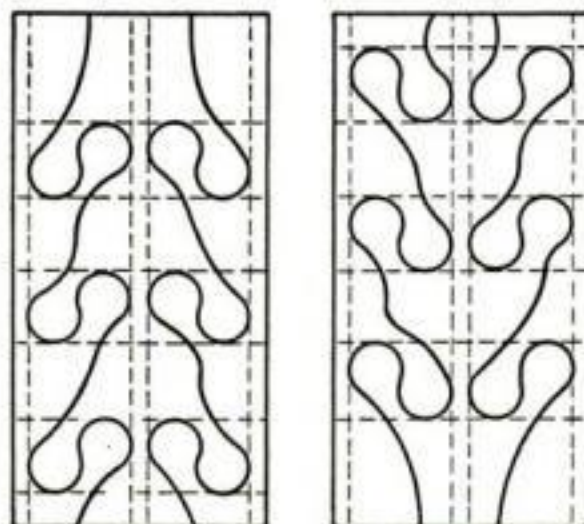
Soldering pewter may be done with a gas or alcohol blowtorch, but care must be taken not to melt the metal. First apply pewter soldering flux to the joint, and preheat the metal until the flux begins to bubble. Then apply the softest available pewter solder in little pellets cut from the wire.—K. S.

Double-Sawed Block Puzzle Tests Skill in Assembling

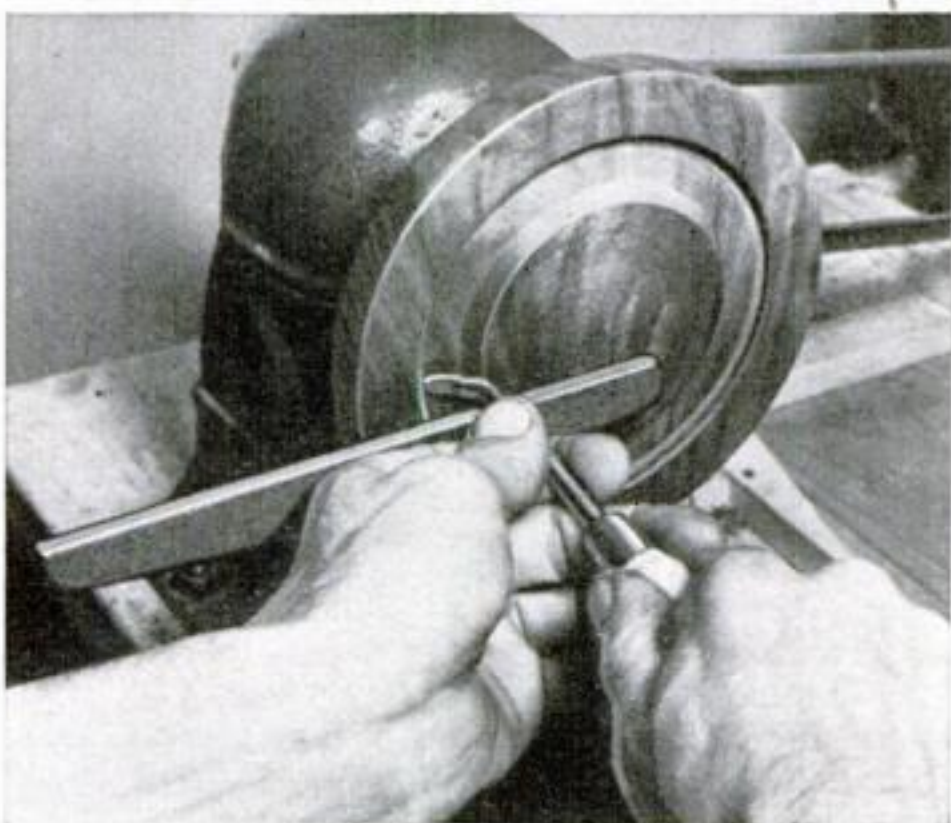
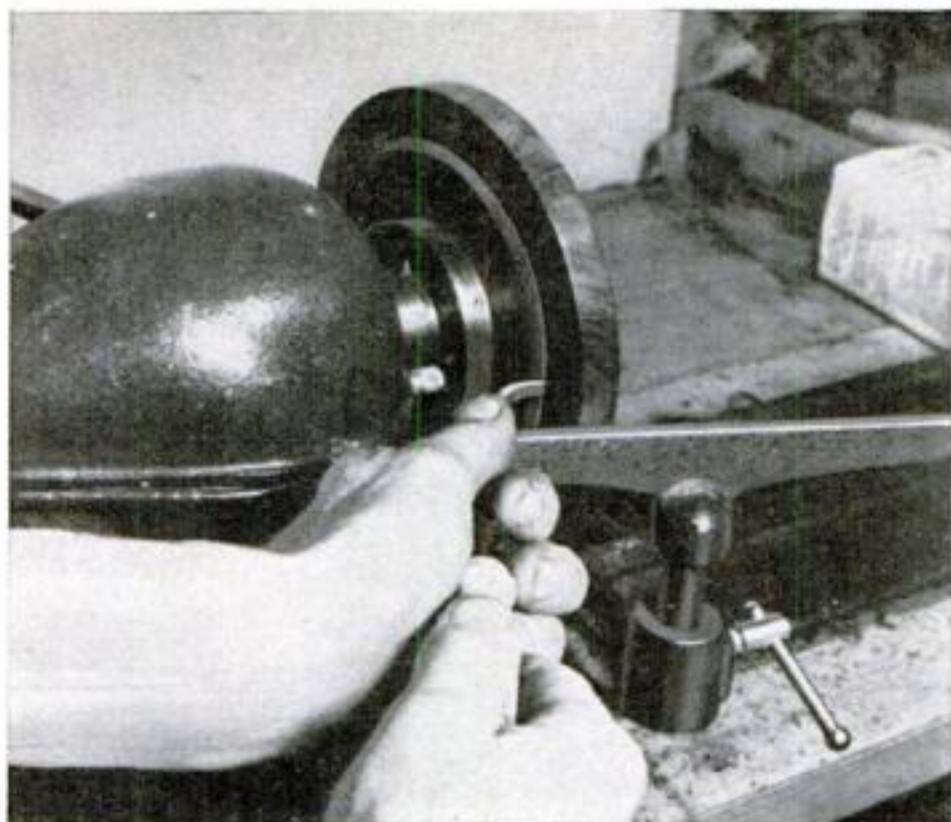
A PUZZLE that always arouses curiosity can be scroll-sawed from a block of mahogany, walnut, or other wood that does not split readily. A good size is 2" by 2" by 4".

Divide the length by seven and use this as a unit of measurement. The space at one end is just half this, and the space at the opposite end is one and a half times it. The five spaces in between are each one unit long. Lay out a space $\frac{1}{8}$ " wide down the middle lengthwise, and a $\frac{1}{8}$ " margin along each edge. Draw the loops and saw with a thin blade.

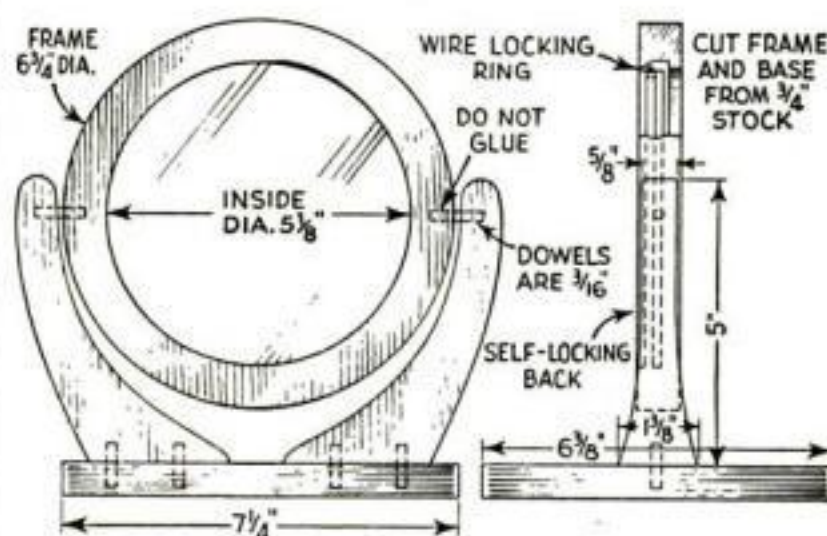
Now turn the block at right angles and lay out the next side in the same way, but place the short space on the opposite end as indicated. Clamp a strip along the sides to prevent shifting, and saw as before. Make sure that the ends of the loops in all cases split the division lines, or there will be small pieces on the inside of the puzzle. Make the layouts just alike except in one place on each end, which will prevent the pieces from being interchangeable.—W. H. G.



The assembled puzzle and, at left, how the sides are laid out so they interlock properly



Above, the completed easel-type frame. At left above, cutting the retaining flange. Left, grooving the circular piece for the glass. Below, how the frame is constructed



Walnut Photo Frame Has Novel, Self-Locking Back

NOVELTY, exceptional simplicity, and beauty are combined in this easel-type picture frame.

The oval base measures $7\frac{1}{4}$ " by $6\frac{3}{8}$ " and is turned from $\frac{3}{4}$ " walnut stock. This is done by mounting a circular piece on the faceplate $\frac{3}{8}$ " off center, turning it down, then remounting it $\frac{3}{8}$ " off center on the opposite side, and again turning it to obtain the desired oval.

For the frame a circular piece of $\frac{3}{4}$ " material is turned to an outside diameter of $6\frac{3}{4}$ " and an inside diameter of $5\frac{1}{8}$ ". A groove $\frac{1}{8}$ " deep and $\frac{1}{4}$ " wide is cut for the glass as indicated in the end view. For this purpose a special tool may be made by bending and sharpening the point of a screw driver. The retaining flange for holding the back of the frame is cut in at an angle with the same tool from the rear side, as illus-

trated in one of the photos. The finish should be applied to the frame, however, before this back groove is cut completely through.

To make the back, a piece of $\frac{7}{16}$ " walnut is glued to a piece of waste stock, mounted on the faceplate, and turned to a diameter of $5\frac{3}{8}$ ". In the edge, a groove $\frac{1}{8}$ " deep is turned to take the 16-gauge retaining wire. Note that this groove is deepened at top, being approximately $1\frac{1}{8}$ " deep, and that the points of the retaining wire extend into a $\frac{3}{8}$ " hole bored through the back near the top. Two pins keep the hooklike ends of the wire in the proper position.

To insert the back in the frame, compress the wire with the fingers and push the back in. The wire automatically springs out and engages the shoulder of the frame. To remove the back, insert a screw driver into the $\frac{3}{8}$ " hole and turn to the right, thus

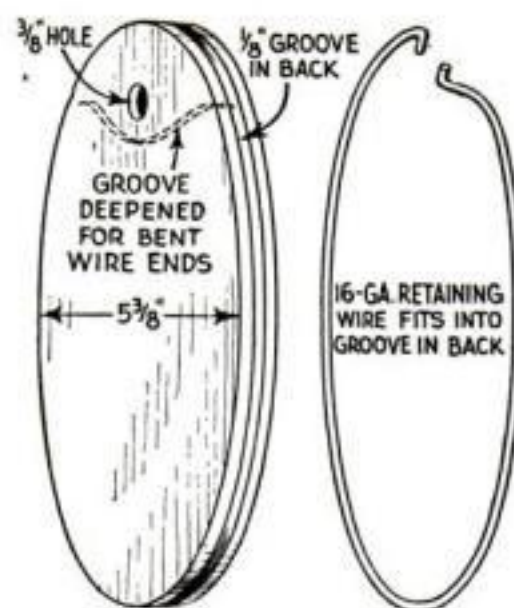


Average Time
 $8\frac{1}{2}$ hours

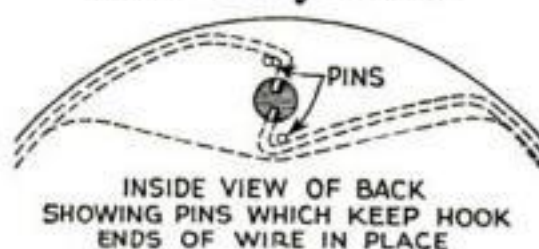
compressing the wire and permitting the back to slip out, as is shown in a photograph at the right.

With a jig saw, the uprights are cut to shape from $\frac{3}{4}$ " by $1\frac{3}{8}$ " by 5" walnut. The frame is hung between the uprights by means of $\frac{3}{16}$ " dowels, which are glued into holes in the uprights, but not into the holes in the frame. The dowels should fit snugly so the frame can be adjusted for any angular setting desired.

It is easier to finish the various turned parts of the frame before they are removed from the lathe. The uprights should be sanded smoothly and finished by hand. Apply a coat of paste wood filler and, when it shows signs of drying, remove the surplus across the grain with a cloth. Allow the

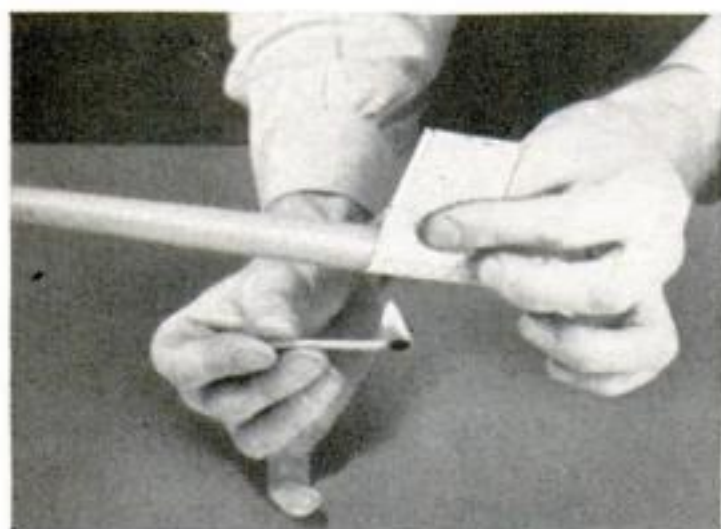


Details of Back



Retaining wire is released by inserting a screw driver in the rear hole

filler to dry overnight. Then apply two coats of thin shellac, and rub with fine steel wool or powdered pumice stone after each coat.



Pictures Transferred to Candles by Heating with a Match

PARTY candles can be made more amusing and attractive by transferring newspaper pictures and comic characters to them. Cut out the picture and hold it around the candle as shown. Move a lighted match over the paper until the candle wax melts through over the entire area. Remove the paper after the wax has again hardened.

STIPPLE COAT

[PAINTING]

A stipple coat for use on interior walls or craftwork projects that are to be given a stippled and glazed finish can be mixed as follows:

Soft paste lead,	5 lb.
Plaster of Paris,	10 lb.

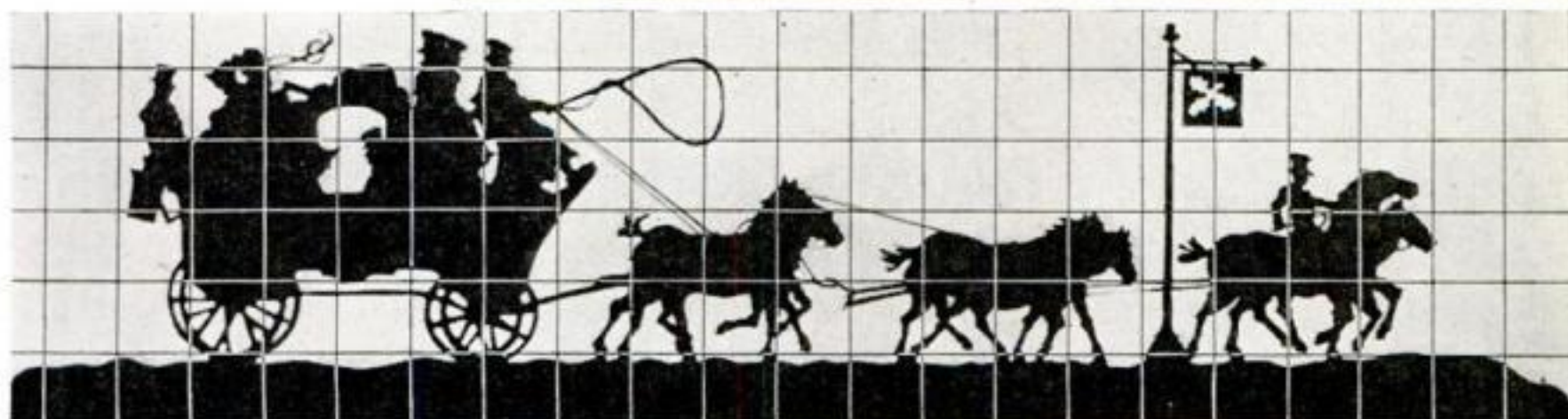
Use flatting oil to make as thin or heavy a consistency as required. For most wall work, thin to a very soft paste that can be brushed on from $\frac{1}{16}$ " to $\frac{1}{8}$ " thick. It is then stippled with a flat floor-scrubbing brush dipped in water, a so-called "Dutch stippler," a wad of crumpled paper, or the cut face of a sponge, according to the texture desired. Do not coat too much wall surface before stippling, and avoid any regular pattern effects. Let dry overnight before painting or glazing.

POPULAR SCIENCE MONTHLY SHOP DATA FILE

Cardboard Decorations Cut Out on Jig Saw

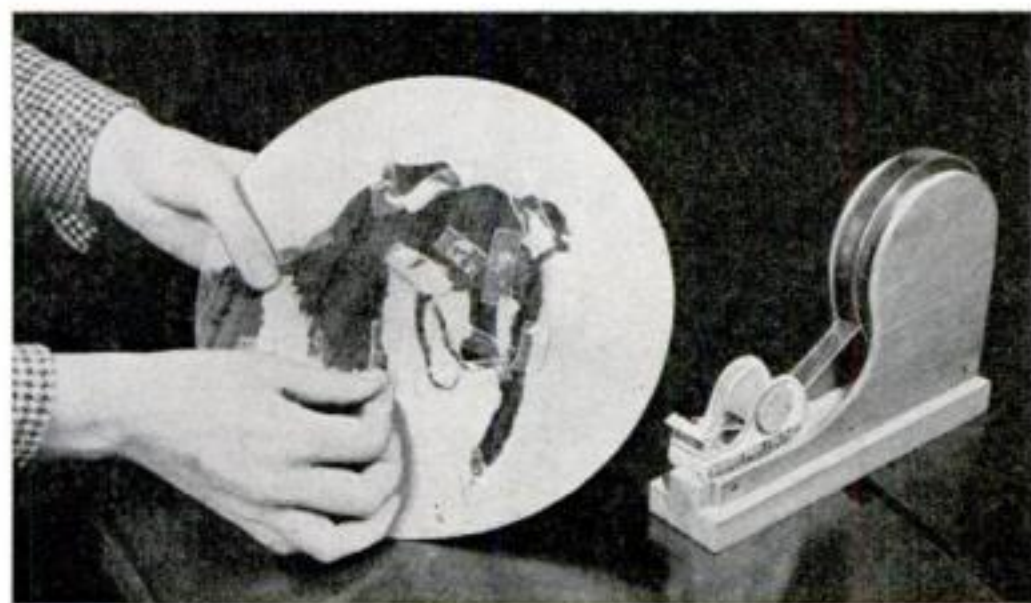
WHEN a number of cardboard figures are required for advertising or decorative purposes, they can be quickly cut on a jig saw. The figures are first printed with any available type of office duplicator. They are then fastened in groups of fifty or less to a sheet of plywood with brads outside the outline. These pads are cut with a medium-fine blade, all the inside cuts being made first. A stiff wire support is fastened to the back of each figure with masking tape as shown. The wire extends $\frac{1}{2}$ " below to fit into a hole in a wooden base.

Silhouettes are prepared in the same way. The old train was cut from fourteen-ply mat board, ten at a time. Such long silhouettes are cut in several parts and mounted on a thin board at the base. Delicate parts like the signpost in the coaching silhouette should have an extra wooden support cemented to the back. For permanent use, plywood is better for pieces as large as these.



With the aid of a power jig saw, banquet place cards and decorative silhouettes can be made in quantity

Cellulose Tape Saves Time in Intricate Inlay Work



TRANSPARENT cellulose tape aids in the sawing, assembly, and application of veneer inlays. By taping the stacked veneers before sawing, more laminations may be cut at one time because pressure boards are unnecessary. In assembly, parts may be removed and adjusted without trouble, and there is no danger of losing any small pieces once a picture or design is assembled. The tape is readily pulled off after use and does not affect the veneer.—DON R. FOSLER.

Heart-Shaped Jewel Box with Inlaid Initial

SENTIMENT and jewelry go hand in hand, so what's more appropriate than a heart-shaped jewel box?

Scraps of clear white pine, walnut, maple, or other woods may be used. Scroll-saw the box from a block of light-colored wood, $1\frac{1}{4}$ " by 7" by 7", and leave the walls $\frac{1}{2}$ " thick. Sand inside and outside on the drum sander or by hand. Make the bottom of the same wood and the cover of $\frac{1}{4}$ " walnut or other dark-colored wood.

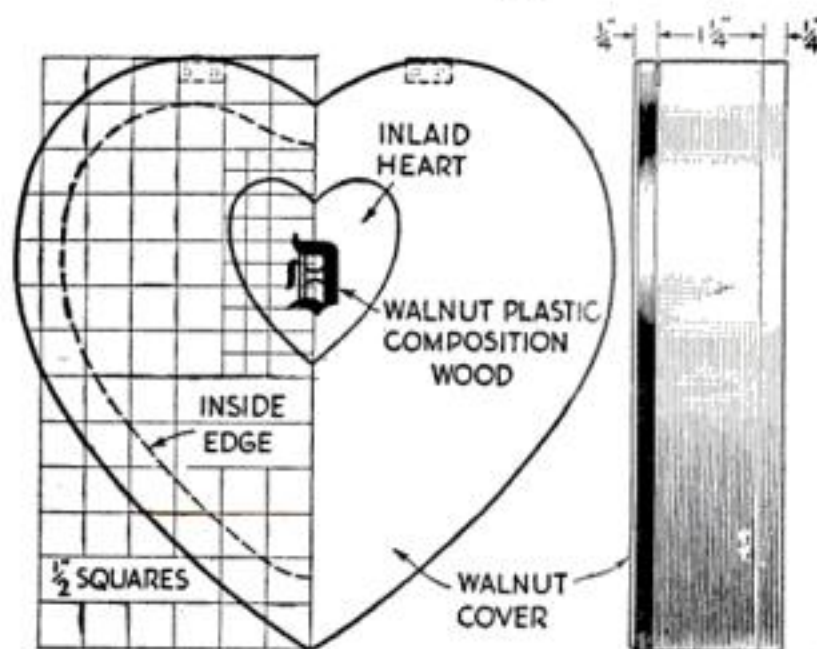
To inlay the cover, first cut a small heart from $\frac{1}{8}$ " thick, light-colored wood. Lay it in place, scribe around it, then cut a recess to a depth of a little less than $\frac{1}{8}$ ". When the inlay fits snugly, glue it in place. Sand it flush with the lid. Next, select a letter to use as the initial, mark it on the small heart, and cut it in about $\frac{1}{8}$ " deep. Fill with walnut-colored plastic composition wood, let it dry, and sand the surface flush with the lid, ready for finishing.

Apply $\frac{1}{2}$ " hinges as shown and attach a small, fine chain to keep the lid from going back too far. Three coats of white shellac will give a good finish. Rub with fine steel wool between coats, and rub the last one down with fine steel wool and thin oil. Glue velvet on the bottom of the box, both on the inside and outside.—CARL G. ERICH.



Average Time
3 hours

The jewel box makes an excellent present for Valentine's Day



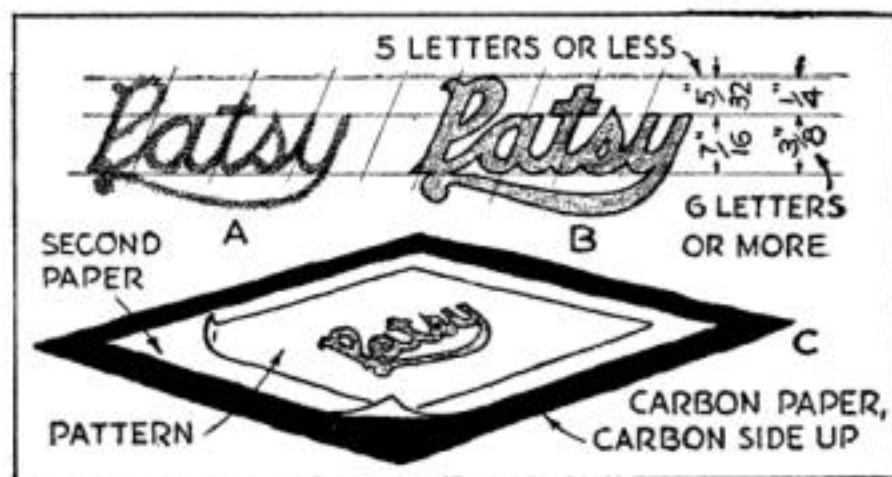
By reversing almost any short name, it can be developed into a decorative design for a pin

Double-Name Wooden Brooches

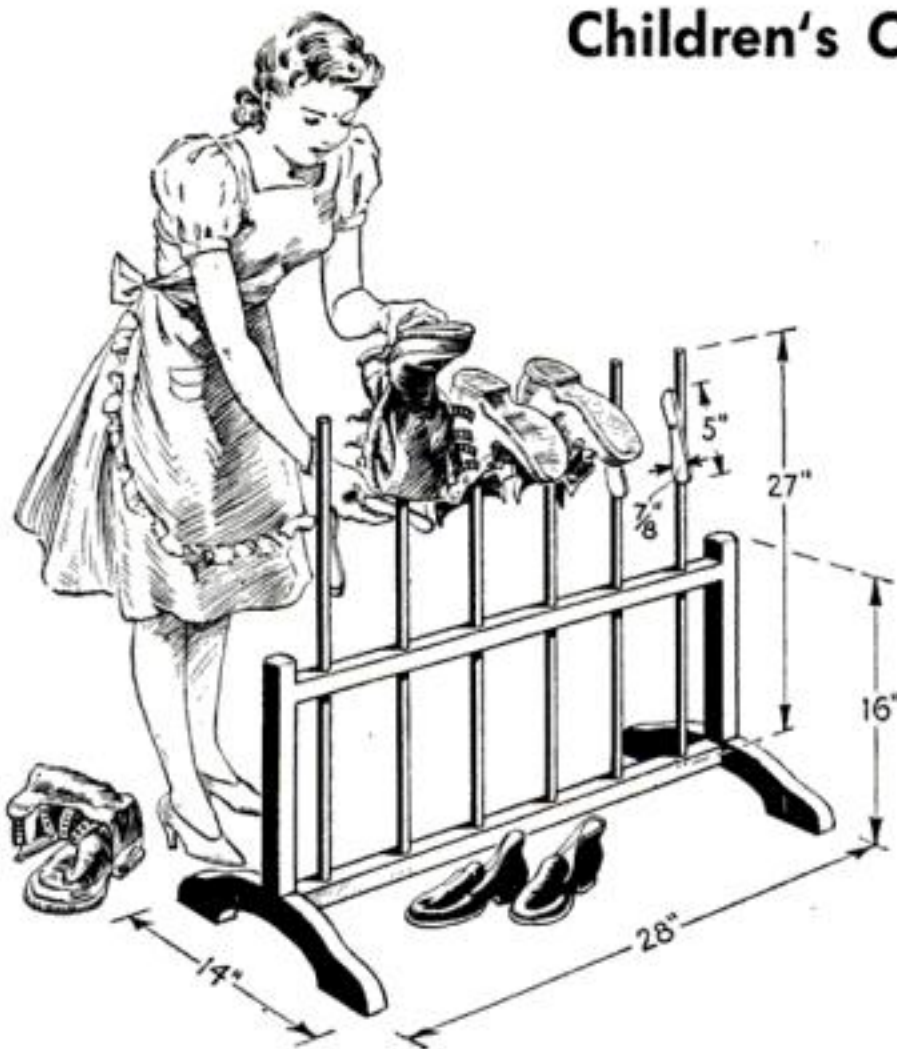
IN THESE novelty brooches, which are scroll-sawed from wood, the wearer's first name appears as an interwoven design.

Write the name with a heavy pencil as at A, and outline the letters as at B. Then lay the sketch on another piece of paper and place both on the carbon side of a sheet of carbon paper as at C. When you trace over the letters again with a pencil, the carbon paper will transfer the name in reverse on the second sheet. Cut out the two names roughly and paste them together with the ribbonlike "flourishes" inside or out, as seems best. You will find that short names work up better than long ones.

Paste the final pattern on $\frac{1}{8}$ " plywood and cut out the design with a scroll or coping saw. A groove for a safety pin can be cut in the back with the point of a penknife. After sanding the brooch, hang it from a wire hook and dip it in spraying lacquer sealer or other suitable finish. Drain for a few seconds and lay on newspaper to dry. Then dip it a second time. Attach a small safety pin with celluloid cement.—E. L.



Children's Overshoes Dried Quickly on Rack



CHILDREN'S overshoes or boots can be dried quickly on the rack illustrated. It consists of a frame made from $\frac{3}{4}$ " scrap pine and six $\frac{1}{2}$ " dowel rods 27" long. Slip the dowels through holes in the top of the frame and into sockets at the bottom. Just hanging the boots over a dowel doesn't open them enough for ventilation, so fasten a "spreader" made from $\frac{1}{4}$ " plywood to each dowel. Set the screws a little off center so that when not in use the spreaders will hang down.—FRED H. SCHULTZ.

Uses for Discarded Glass Cutter

AFTER it has outlived its initial usefulness, a glass cutter of the conventional steel-wheel type can still cut paper, light cardboard, copper foil, gold and silver leaf, celluloid, and film. It is particularly useful for cutting paper patterns.

Decorative Metal Articles Enriched by Simple Methods of Etching

ETCHING is one of the most fascinating and least expensive ways to decorate small metal objects. It is a field limited only by the ingenuity of the craftsman—he can copy designs or work out his own, then transfer them to articles he has made or purchased. At the right is a butterfly design etched by the method explained on the data card below, which is the third in the series.



COPPER AND BRASS

[METAL ETCHING—3]

The metal should be thoroughly cleaned with any available dry abrasive such as whiting, plaster of Paris, or dry lime, and it must be free from finger prints. All portions not to be etched should be painted with an even coat of asphaltum varnish. If a picture is to be etched in, the entire surface may be coated with the asphaltum and, when this is thoroughly dry, the design traced or drawn on the asphaltum with a soft lead pencil. A sharp scratch awl or other needle-pointed tool is then used to cut the lines through to the metal.

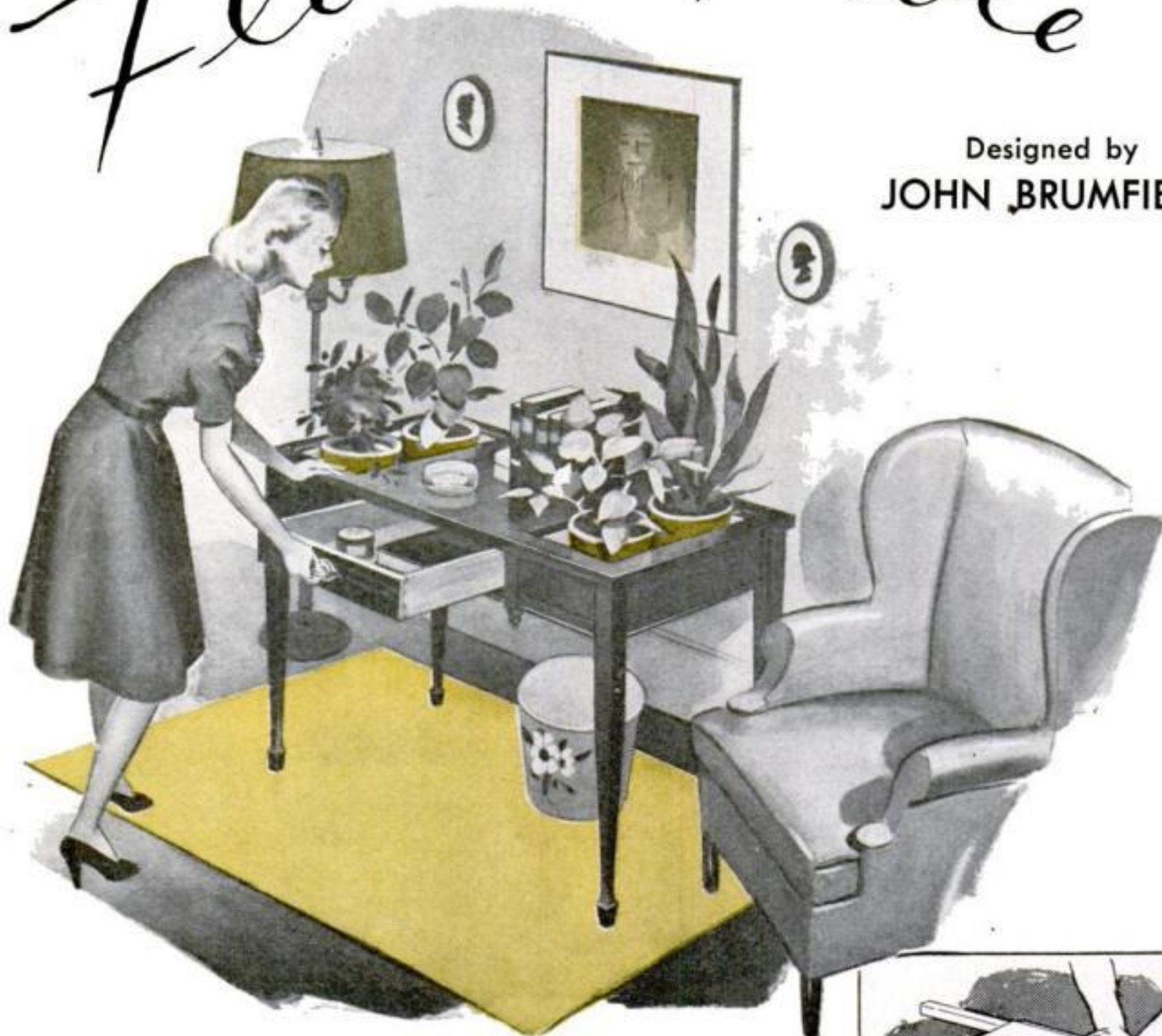
When the piece is ready for etching, lower it into the acid bath. If full-strength commercial nitric acid is used, it will etch copper and brass to a depth of about 0.002" in a minute. (With nickel silver, the acid requires about five minutes to etch to the same depth.) With full-strength nitric acid the etching will be deep enough for all ordinary purposes in from a minute to a minute and a half. A half-and-half solution will require much longer, but should be used where a deep etch is desired. Be careful not to allow the acid to come in contact with the hands or clothing.

Remove the asphaltum with kerosene or lacquer thinner, and wash and polish the metal, or color it as desired.

POPULAR SCIENCE MONTHLY SHOP DATA FILE

Flower Table

Designed by
JOHN BRUMFIELD

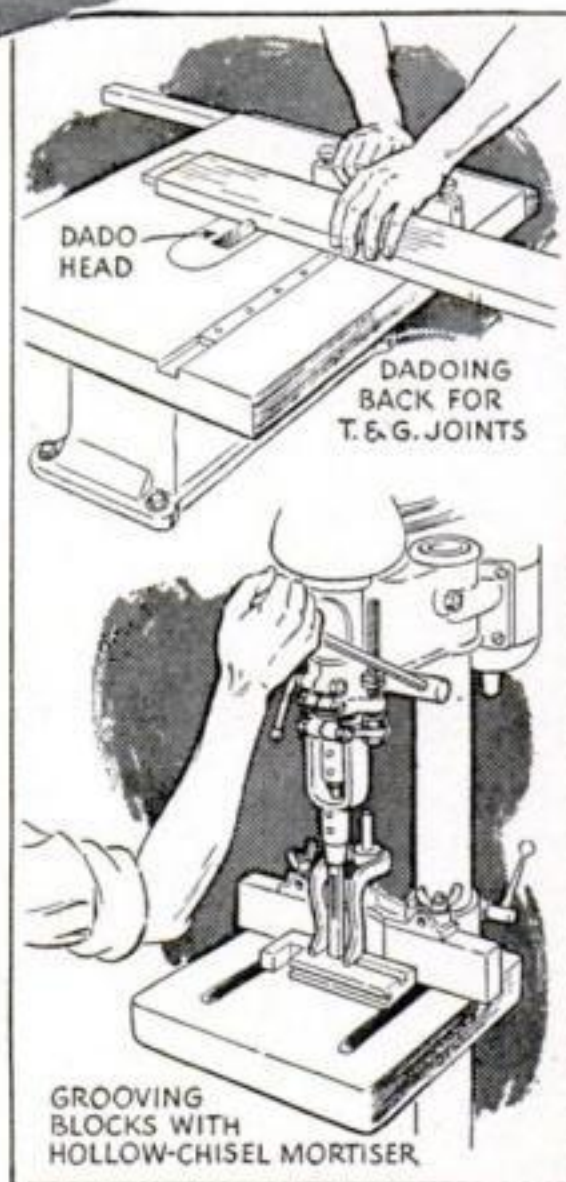


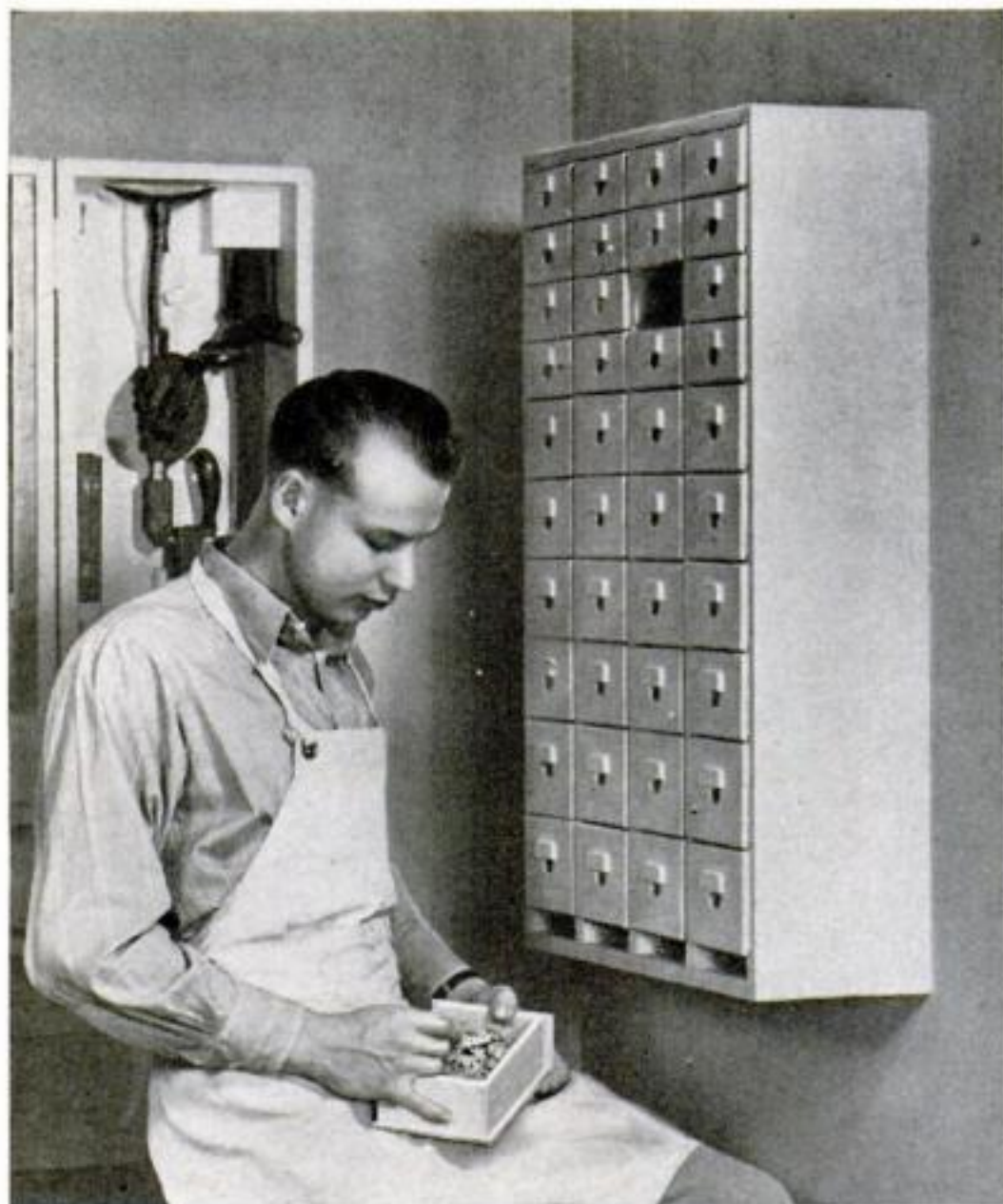
POTTED plants set out in any room in winter seem to give a gentle hint of spring and add a soft and pleasing accent of nature to the cold mahogany and walnut of formal furniture. The question is, where to put the plants so they will look as if they "belong."

One of the best solutions is to construct a flower table of the type illustrated. This has a copper-lined recess at each end for holding flowerpots, and at the same time a central space is left clear for books, smoking accessories, or other objects, and there is a drawer for holding various odds and ends.

Mahogany or walnut is the preferred wood, although any cabinet hardwood will serve. Mortise-and-tenon joints will give the strongest and most satisfactory construction, but dowels could be used instead if a simpler method is desired. The work will be simplified if the two blocks at each side of the drawer-opening are glued in place before the complete assembly is attempted. The top is held with table-top fasteners or screwed to $\frac{3}{8}$ " strips.

The sheet-metal pans are preferably made of copper with lapped and soldered joints, or with the corners folded so that no solder is necessary. If you wish to avoid the metal work, have a local tinsmith make these up.





Bottom openings are for lists of stored parts

Storage Cabinets

FOR
HOME WORKSHOP
MATERIALS

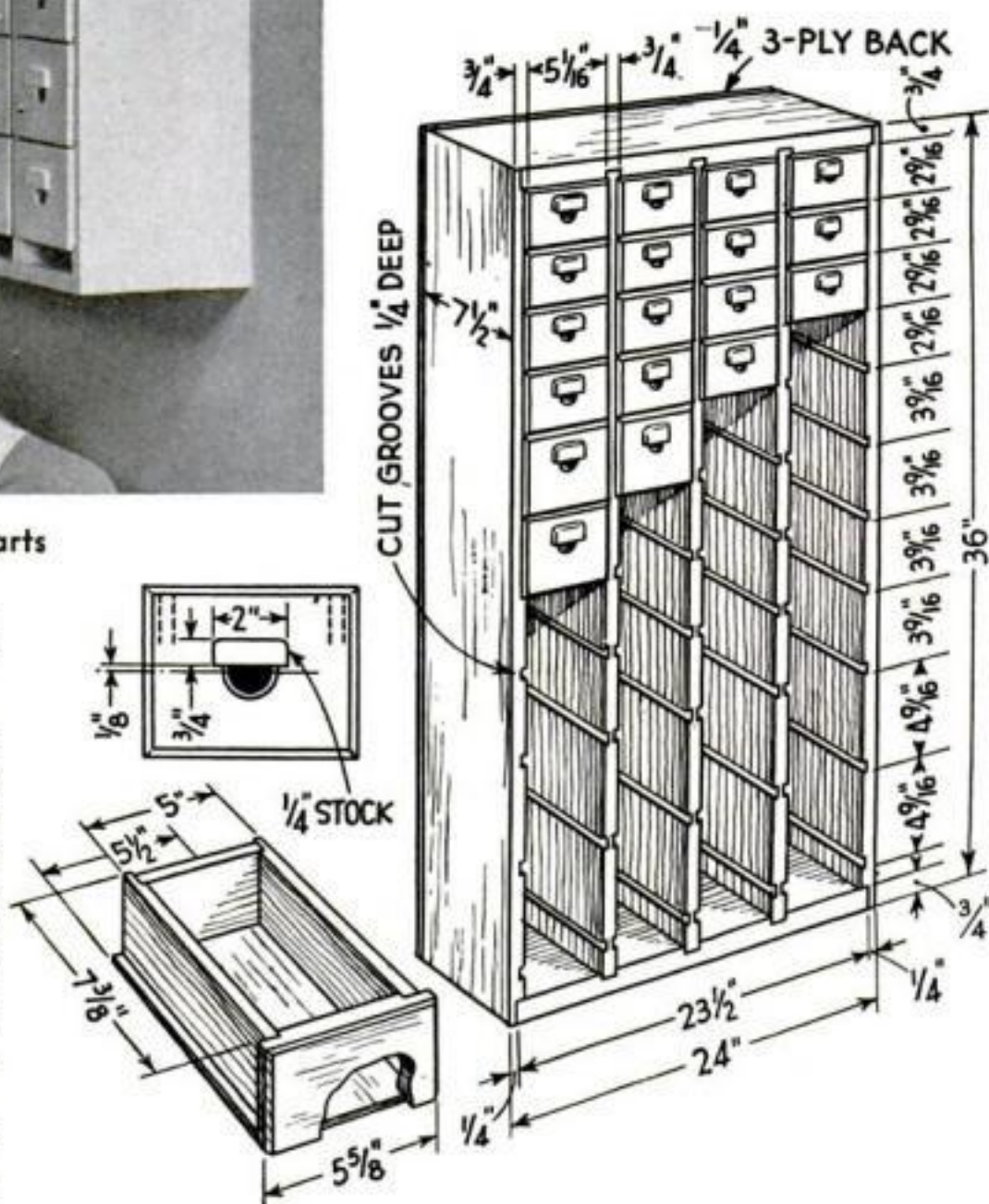
By **EDWIN M. LOVE**

THE old adage, "A place for everything, and everything in its place," is just as applicable to the home workshop as the drawing room. The enjoyment, the quantity and quality of work, and to some extent the safety of the operator depend much on the neatness and orderliness of the place and the accessibility of tools and materials.

The enterprising home mechanic keeps on hand an astonishing variety of supplies, some new, others salvaged from scrap bins and junk yards. These must be put away somewhere, preferably in drawers and on shelves tucked away under benches or in wall cabinets, in order to reduce to a minimum bulky extra cabinets that use up precious floor space.

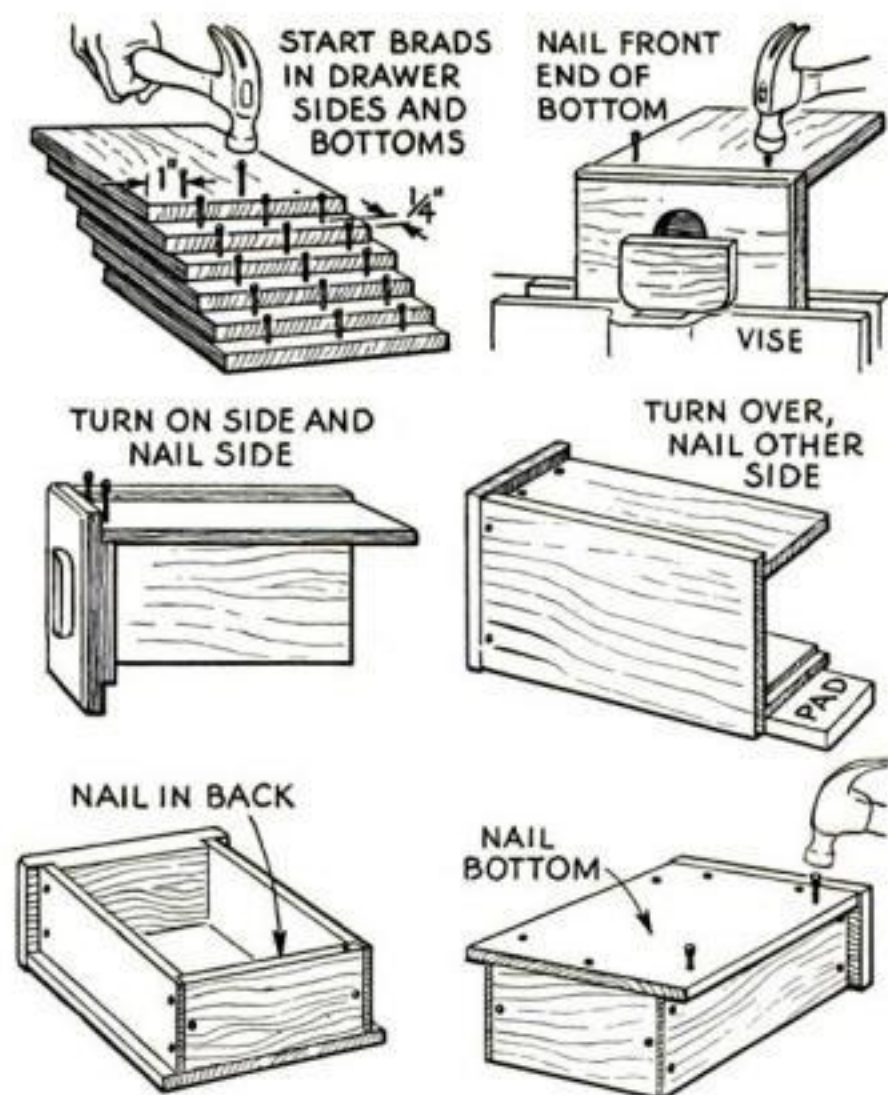
The small parts cabinet illustrated, built for our model shop, is a good example. Sixteen small drawers $2\frac{1}{4}$ " deep inside, sixteen $3\frac{1}{4}$ " deep, and eight $4\frac{1}{4}$ " deep are housed in a wall cabinet $24"$ by $36"$, conforming to the size of the tool cabinet first built for the shop (P. S. M., Jan. '40, p. 161).

Since the many drawers constitute a production problem, some hints are in order. The material used was No. 3 knotty pine



bought as $1"$ by $12"$ stock, costing $4\frac{1}{2}$ cents per board foot. It was resawed on the circular saw. Lumber for the fronts was ripped and jointed to width and rabbeted $\frac{1}{4}"$ by $\frac{1}{2}"$ to take the bottoms. Then the side stock and back material were sized for width and ripped to thickness. Wood too wide was ripped from one edge and finished from the other edge.

All drawer sides are the same length. Set up the saw with a dado head $\frac{3}{8}"$ wide and a regular blade. Set the miter-gauge length bar for $7\frac{3}{8}"$, and cut the pieces with the smooth side down and the dado cutting $\frac{1}{8}"$ deep. Then dress rough sides on the jointer, reducing the pieces to about $\frac{5}{16}"$ thick.



Use a "one, two, three" production-line system for assembling drawers. You'll save considerable time

Be sure to use a thick push stick on top to protect the hands.

A similar saw set-up is used for the fronts, with the dado head cutting $\frac{5}{8}$ " wide and $\frac{1}{2}$ " deep. Cut off a piece, turn it end for end, and cut the other rabbet.

Remove the dado and cut the backs $\frac{1}{4}$ " longer than the fronts from shoulder to shoulder. The bottoms are all alike, $5\frac{1}{2}$ " by $7\frac{7}{8}$ ", made from three-ply fir wall board.

Next add the pulls on the drawer fronts by boring $\frac{7}{8}$ " holes $\frac{5}{8}$ " deep in the centers. The finger catches are glued and bradded $\frac{1}{8}$ " above centers. Chamfer the front corners of the fronts.

Assemble the drawers with glue—liquid or casein—and brads. Time can be saved by systematizing the operations. For example, place one drawer side on the bench and start either two or three brads into it as shown (depending upon whether the drawer is shallow or deep). Lay the second side on top and start the brads in it, and continue in this way. Do the same in starting nails into the drawer bottoms. Then assemble.

Now pick up a front and dab glue on the



Bench and storage cabinet of Halford Thomas, of Alhambra, Calif. Note magazine shelves at right end

end and bottom rabbet shoulders. Clamp it upside down, face forward, in the vise. Nail on a bottom, dividing the front projection evenly. Remove from the vise and turn the front on one side to nail in a side; reverse, and nail in the other side. Now insert a back in the side rabbets and drive two brads in, using a scrap of plywood to level the underside. Also drive one brad from the back into each side, at the center.

Finally, turn the drawer upside down and put two brads through the bottom into each side and one into the end. The bottom projection at the sides can be estimated closely enough by eyesight and feel when driving the first brad in the bottom.

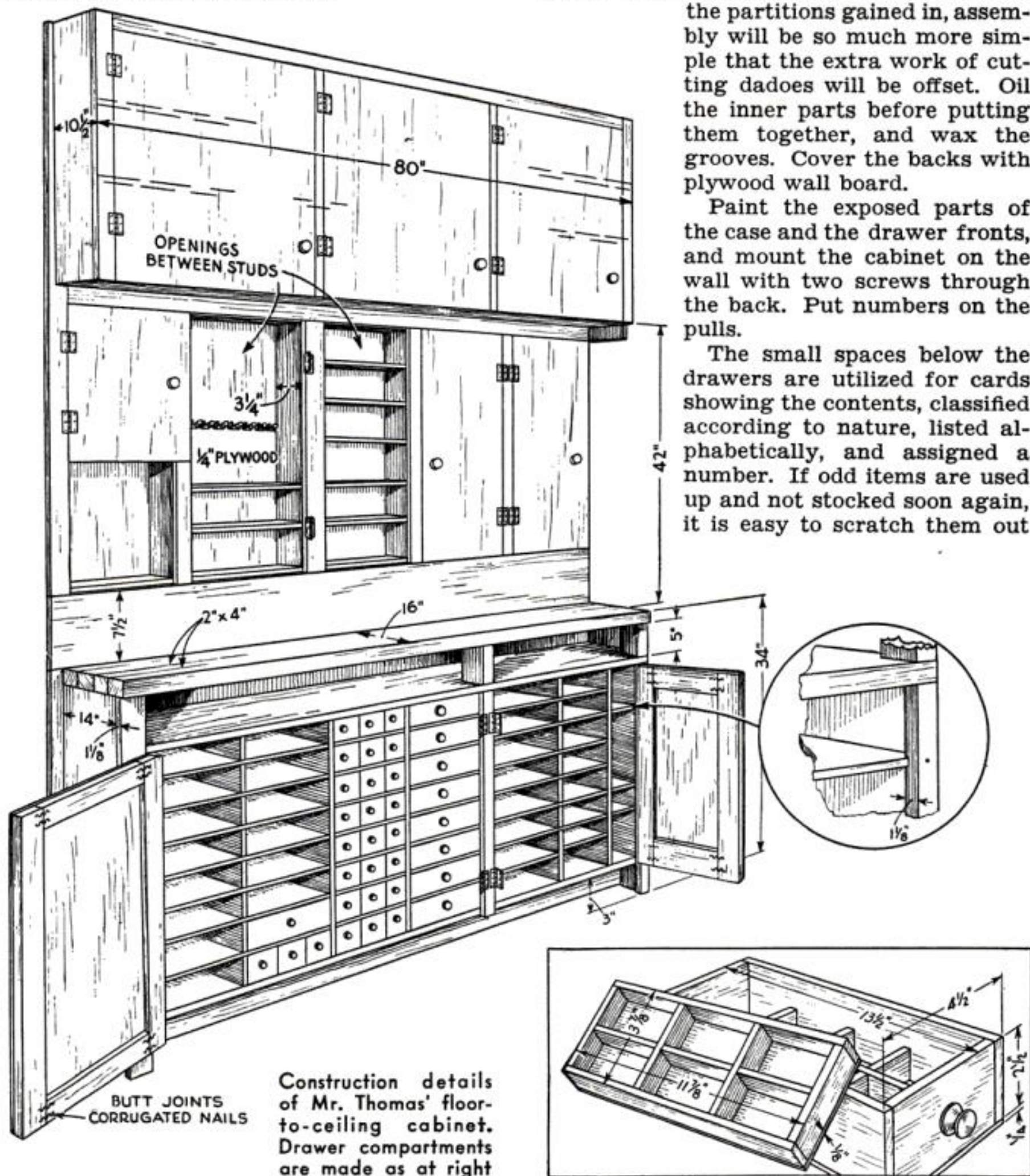
After all drawers are assembled, give the sides and bottom one coat of boiled linseed oil. The insides of the drawers may be oiled, if desired.

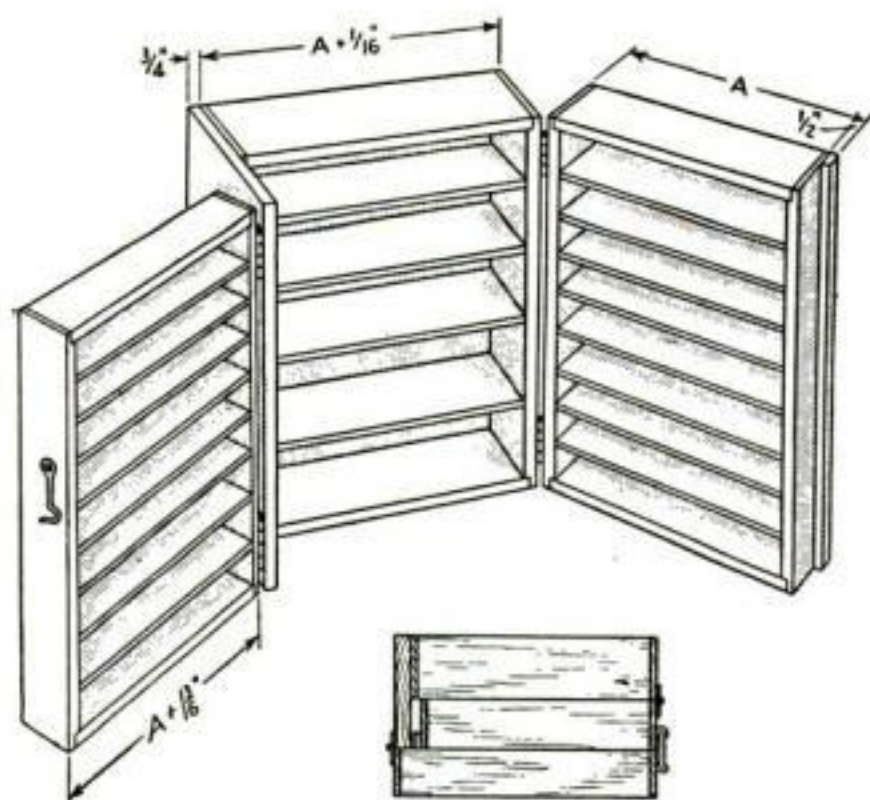
The case is a simple affair with $5/32$ " grooves forming runs for the drawers. Use the two outer cutters of the dado head, separating them with a thin cardboard washer. Cut one side and mark the other side and partitions from it, on the edges. If care is taken to split the line in cutting, and the miter gauge is set exactly square, the grooves should be accurate enough for practical purposes.

The whole case may be put together with butt joints, but if the sides are rabbeted and the partitions gained in, assembly will be so much more simple that the extra work of cutting dados will be offset. Oil the inner parts before putting them together, and wax the grooves. Cover the backs with plywood wall board.

Paint the exposed parts of the case and the drawer fronts, and mount the cabinet on the wall with two screws through the back. Put numbers on the pulls.

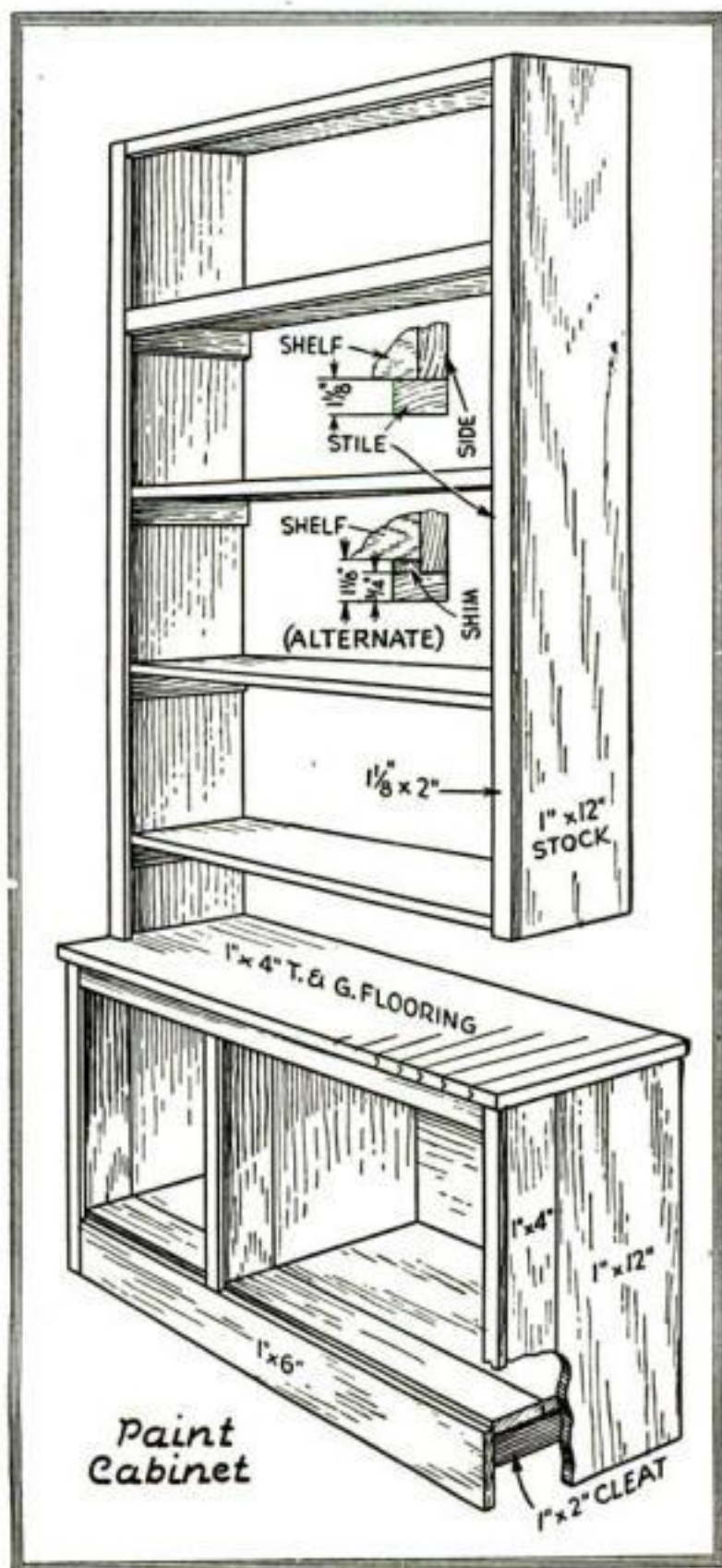
The small spaces below the drawers are utilized for cards showing the contents, classified according to nature, listed alphabetically, and assigned a number. If odd items are used up and not stocked soon again, it is easy to scratch them out





Hinged Cabinet for Glass Containers

A three-piece cabinet for small jars can be hinged, as above, or fastened to the wall in a corner, as at right



Paint Cabinet

on the list and give the number to another article to be stored. Four such lists should be enough for a home shop.

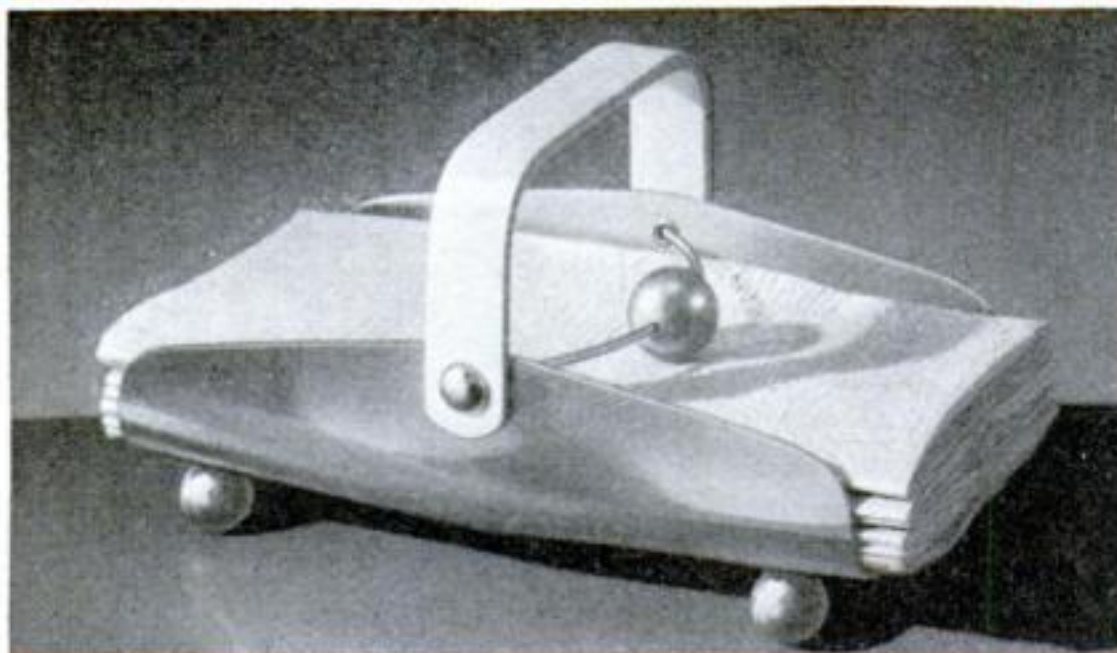
A ceiling-to-floor cabinet, used also as a bench, is an excellent storage medium. Halford Thomas, of Alhambra, Calif., has a good design, which is shown on the opposite page and the second page of this article. Drawers and shelves are hidden by flush doors made by sheathing frames of 1" stock with 1/4" plywood. The small shelves are 1/2" stock. The drawer bins are butt-nailed from thin stuff salvaged from boxes.

Note the compartments and trays. Very small rectangular containers of this kind are good for screws and small parts, but small nails and pins should be stored in wider, shallower containers with rounding bottoms.

Mr. Thomas' paint cabinet is worthy of study. He keeps opened paints in fruit jars, which are closed with caps and rubbers. Note the compartment for the spray pump, and the adjacent paint table. In the compartment at the left of the sprayer are drawers with brushes and stirring sticks, and clean rags. Oily rags must always be stored in metal containers, as they may catch fire from spontaneous combustion.

Cases of shelves for glass bottles labeled to hold screws and small parts are favored by many mechanics. Those in the photograph are screwed to the wall. A space-saving idea is to screw the back case to the wall, hinge a second case to swing right, and a third to swing left. A satisfactory way to keep jars from tumbling from the shelves is to tack narrow strips on the fronts of the shelves, but be sure to space the shelves far enough apart to allow lifting the glasses over the obstructions.

New Appliances



PAPER-NAPKIN HOLDER. A polished metal ball on a pivoted rod keeps paper napkins in their place on this tray; or the device may be detached so that the tray can be used for serving bread sticks, canapés, or delicacies

NEW VACUUM CLEANER. Whenever the dirt bag needs emptying, a brilliant red light flashes on top of a new vacuum cleaner, shown below. Other features include a convenient "toe switch," which eliminates the necessity for stooping over, and an attachment for polishing floors



BAG PROTECTS CLOTHES. Through a hole at the bottom, the hose tube of a vacuum cleaner can be inserted to mothproof your clothes. The specially treated material and zipper keep out dust when the bag is stored



FLOUR SIFTER. Holding two cups of flour, the sifter shown below has a patented cone bottom that permits sifting directly into the measuring cup, thus eliminating extra handling. It levels the flour after sifting



for the Household



AUTOMATIC COFFEE MAKER. Just plug in this coffee maker and forget about it. The switch goes off when the water passes to the upper bowl, but a warming element keeps the finished brew always ready for serving



TRANSFER CANNING LABELS. Home-canned fruits and preserves are enhanced when labeled with these attractive decalcomanias. The transfers are easily applied and can be freshened up with water if soiled



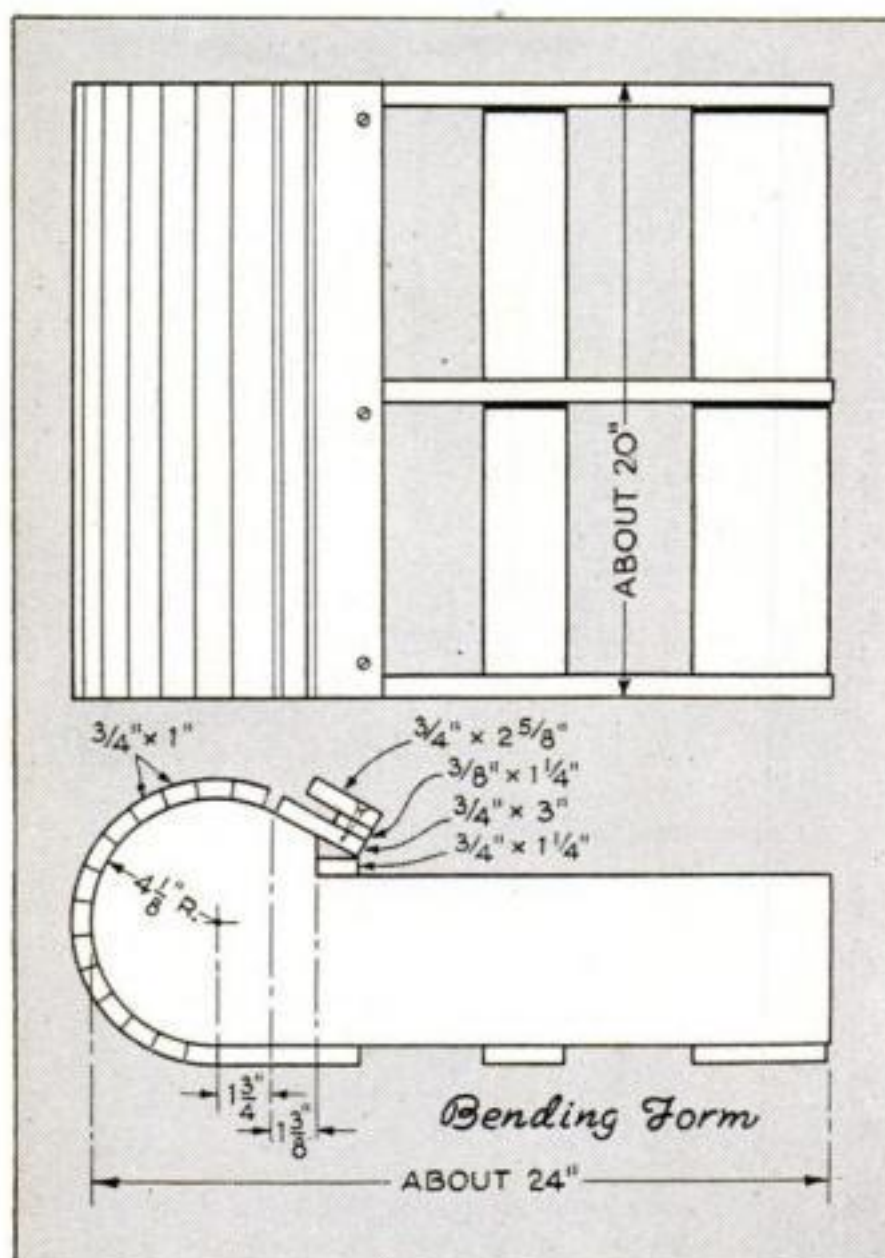
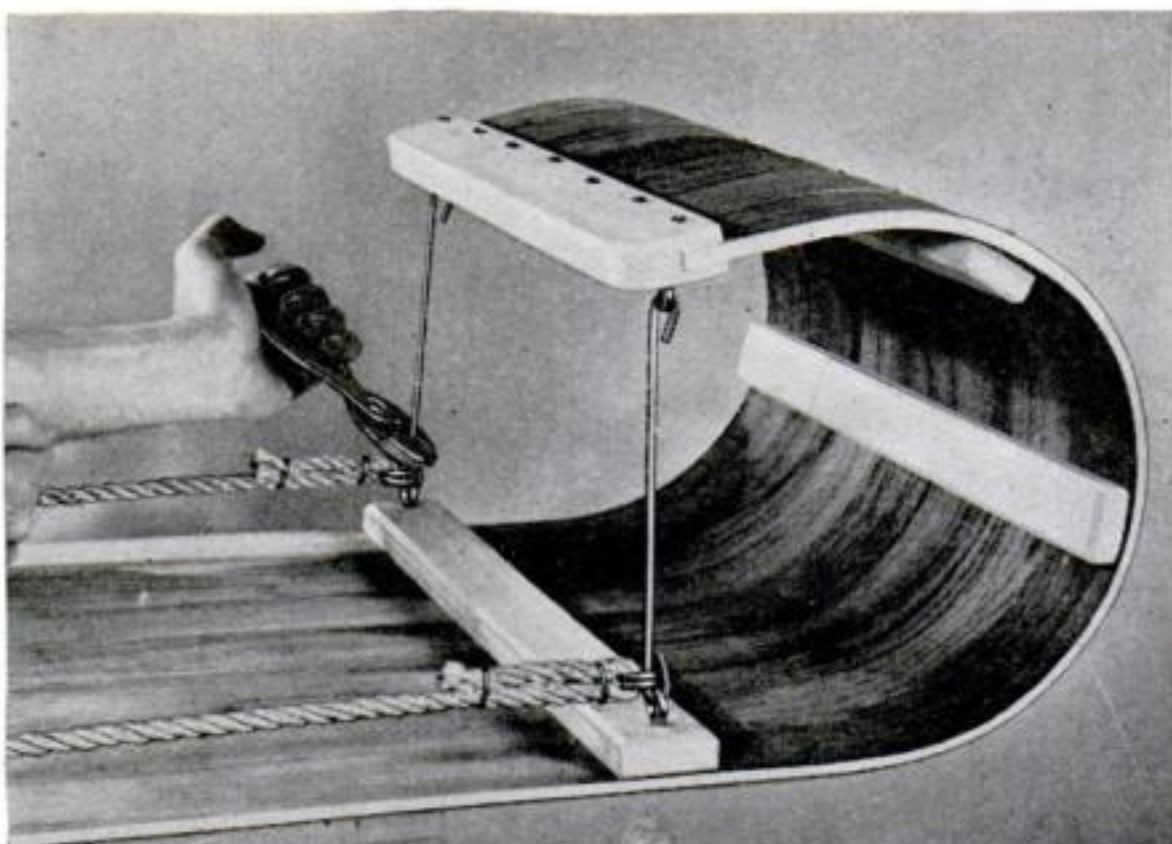
LIGHTWEIGHT IRON. Despite its large ironing surface, the iron at the left weighs only three pounds. A "dial-the-fabric" indicator regulates the temperature, and a ruby safety light glows until the desired heat is reached, when it goes out



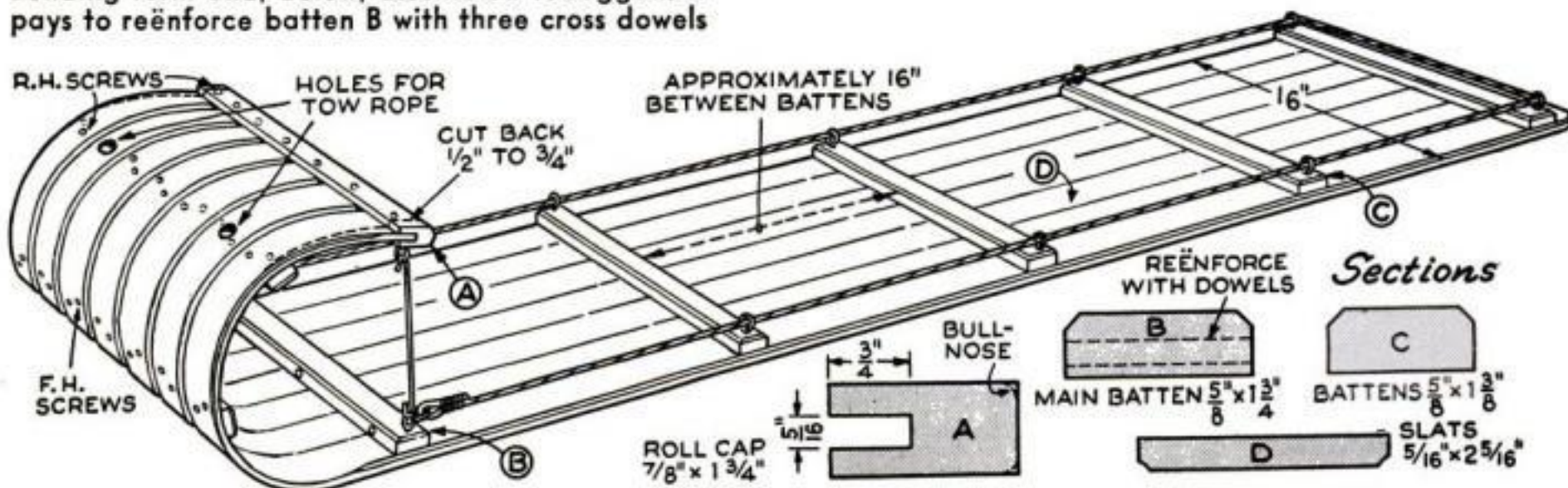
DRIP-PROOF MEDICINE BOTTLE. The improvements in this bottle over the old prescription bottle include a drip-proof pouring lip, raised lines to provide a better grip, increased label space, and a lower center of gravity because of the wider base

Toboggan Building

By REGINALD O. LISSAMAN



Bending form and, below, assembled toboggan. It pays to reinforce batten B with three cross dowels

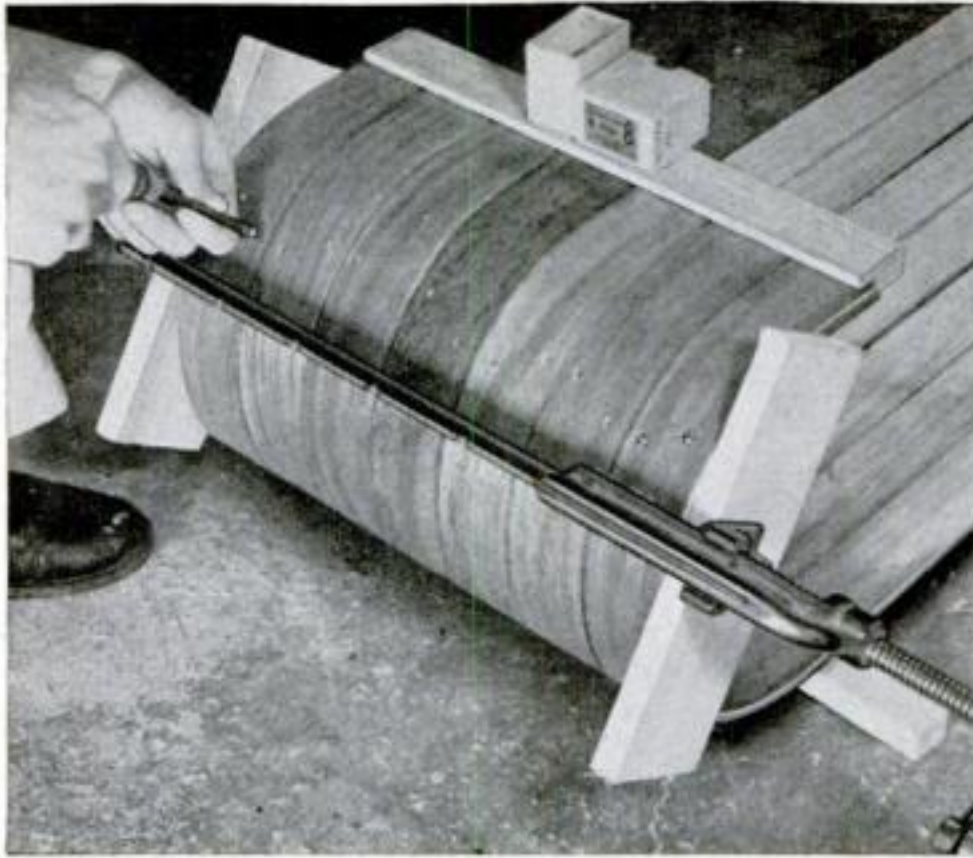


YOU do not have to be a Canadian to learn that tobogganing is one of the most exhilarating and exciting winter sports. It can be practiced anywhere the snow is sufficiently deep, either on a specially constructed slide or on an open hillside.

Toboggans are made in various lengths, but one built from 8' long material is a good average size and will accommodate four people. The best width is about 16". Seven slats $\frac{5}{16}$ " thick and $2\frac{5}{16}$ " wide will give a width of $16\frac{3}{16}$ ". The extra $\frac{3}{16}$ " can be removed from the center slat. Care must be taken to choose a straight-grained wood suitable for steaming such as hickory, oak, maple, or birch. The slats must be chamfered as shown before being bent.

Either of the methods illustrated will be found quite satisfactory for steaming or boiling the wood. An hour and a half of boiling or slightly longer of steaming alone will make the slats quite pliable. The slats are then bent on a form as shown and left on the form for at least two days. The assembling is completed as illustrated.

The upper surface of a toboggan is usually stained and varnished, but the under or running side gets special treatment. Pine



tar burnt in with a torch, as for ski bottoms, is excellent. A good, fast surface, however, may be provided by painting the bottom with two coats of kettle-boiled linseed oil mixed with powdered graphite.

Runners of from $\frac{1}{16}$ " to $\frac{1}{8}$ " strap steel 1" wide are often screwed to the two outside slats and the center slat for extra speed, and on the larger sizes (10' to 14') for additional strength as well.

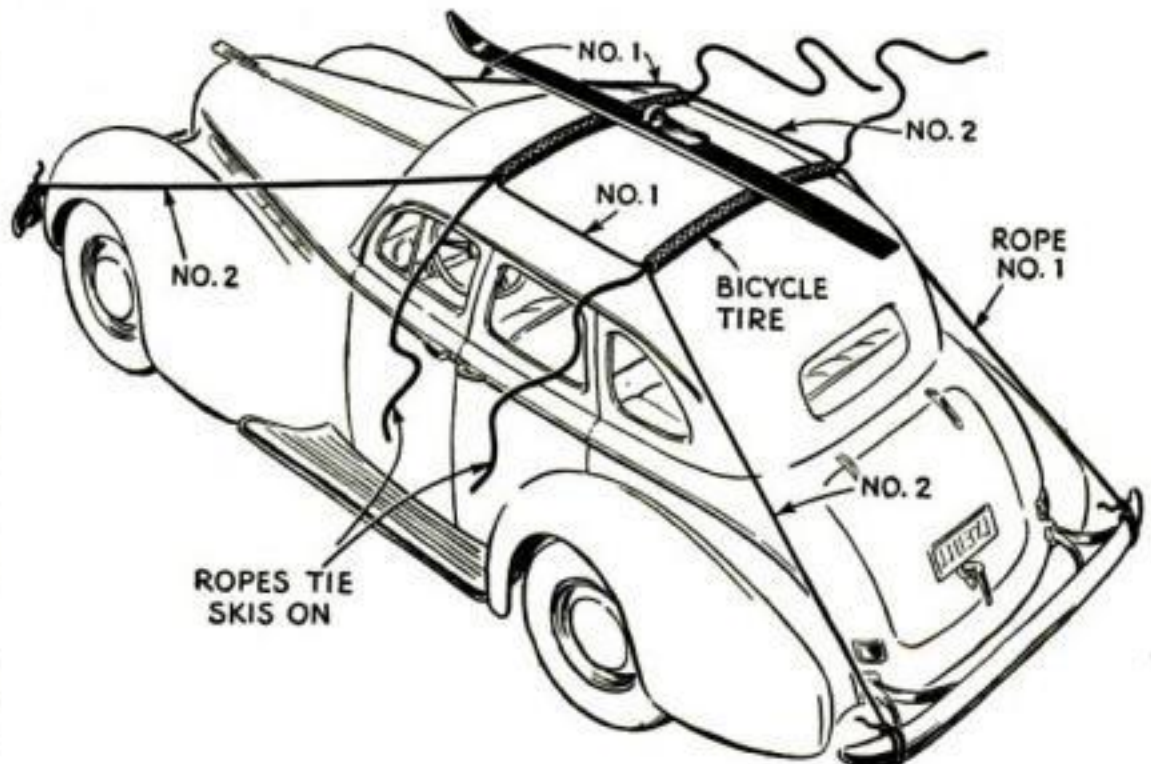
The $\frac{3}{8}$ " tow rope may be passed through holes at the locations shown and knotted inside, or fastened to stout screw eyes placed in the same positions. The handle rope is attached at the front ends as shown. It also serves to hold in the toboggan pad, which may be an old rug or a thin mattress.

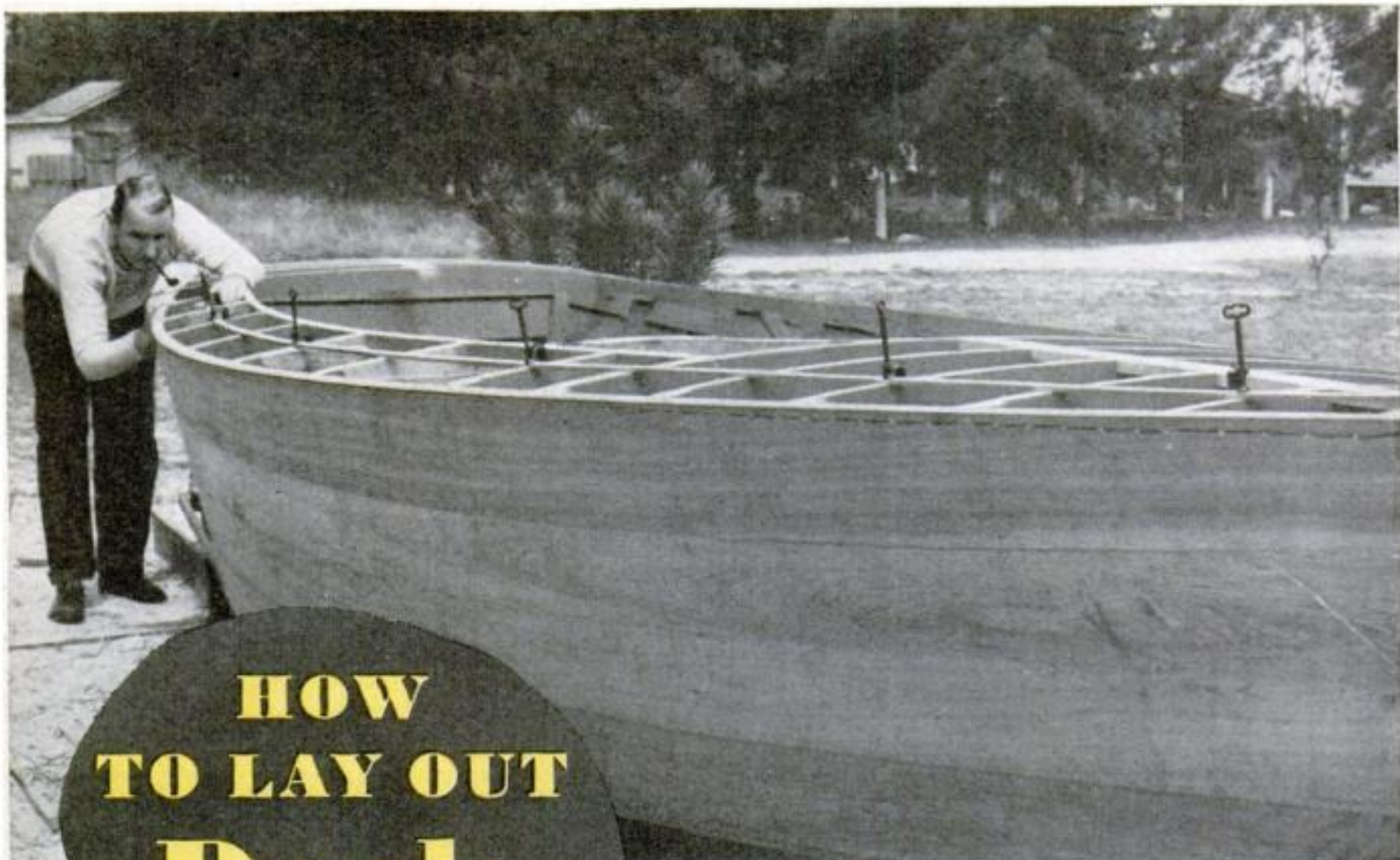


Rubber Tubing and Ropes Form Serviceable Ski Rack

FOR carrying skis on top of an automobile, an excellent rack can be made in a few minutes from an old bicycle tire cut in half (or two pieces of garden hose) and four lengths of discarded clothesline or other rope. The rubber tubing is laid across the top of the car to act as padding, and the ropes are arranged as in the accompanying illustration. Note that the rope marked No. 1 starts at the front bumper, passes through the first tube, then back and through the second tube, and finally to the rear bumper. Rope No. 2 does the same, but starts and ends on the opposite side of the car. The ropes cross inside the tubes. Two other ropes also go through the tubes and are used to tie

down the skis. One good feature of the rack besides its simplicity is the fact it will hold a number of skis.—H. L. DAVISSON.





HOW TO LAY OUT Deck Curves FOR SMALL BOATS

Sighting along a light batten laid over the deck beams will reveal any irregularities in the curve

By Bruce and Willard Crandall

EXCEPT for a few small boats in which all deck beams are cut to the same curvature, a boat builder must lay out the curve of each deck beam separately.

Boat plans sometimes give the exact curves of each beam. In that case, lay out a few points along the curve of the beam and use a light bending batten to fair up and draw the curve. This can be done directly on the lumber from which the beams are to be cut.

In many plans, however, the deck-beam curves are not given, but only the crown—the vertical distance from the sheer line to the center line of the deck, measured at the particular point at which the deck beam is to be located. When even the crowns are not given, you will first have to determine and lay out the deck line.

If you have made a full-size profile drawing of the boat, the deck line can be drawn

in on this, and the distance between this line and the sheer line will give you the crown for each deck beam. Or the deck line can be drawn on a plank instead, and the plank then set on edge, resting on the center of the transom and stem of the boat. Then you can determine the exact crown of each beam.

Once the crown and the half breadth to sheer of each deck beam are known, the curves can be laid out. One of several methods may be used. If you have a large enough floor, you may use a long batten as a compass (Fig. 2). One end of the batten is nailed to the floor; then the board from which the beam is to be cut is moved back and forth until a radius is found that allows your pencil line to pass through the proper points—*S* and *S'*, representing the sheer, and *C*, representing the center of height of the crown.

Figure 1 shows another method. Nails are driven at points *S* and *S'* into the material from which the beam is to be cut. Two straight battens, each longer than the finished deck beam, are then adjusted so that they lap over each other, making a "V" at the point *C*. Next the two battens are nailed firmly together, after which the curve can be drawn by placing the pencil in the "V" and swinging the two battens back and forth, always keeping them against the

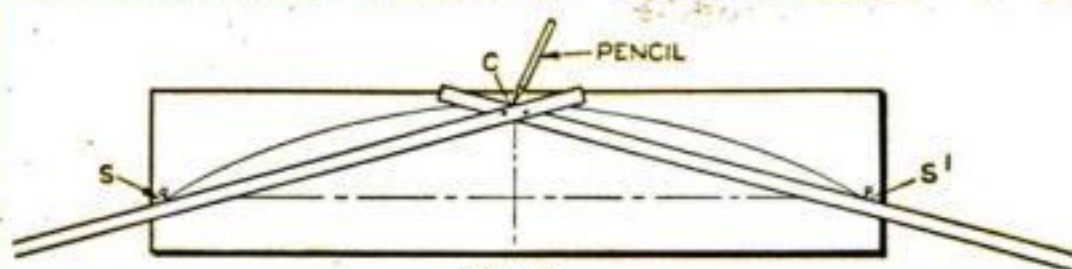


Fig. 1

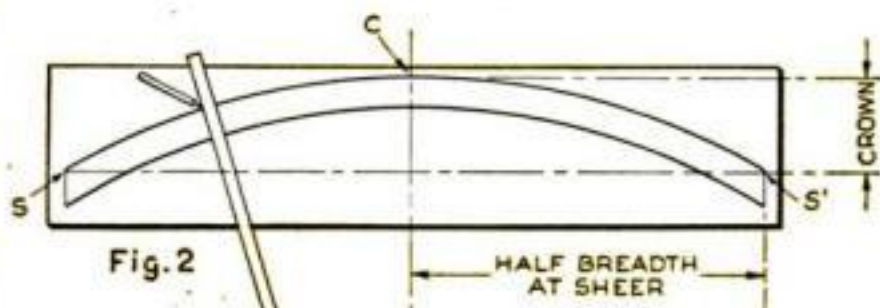


Fig. 2

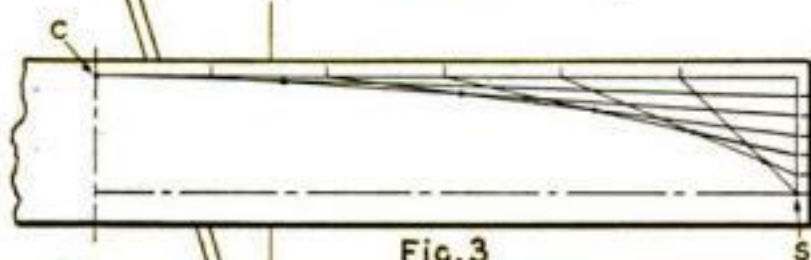


Fig. 3

Methods for laying out curves for deck beams when crown and sheer are known

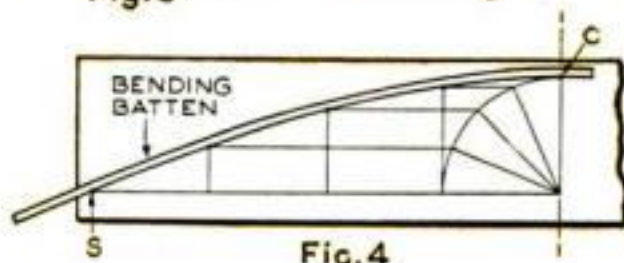


Fig. 4

nails fastened to the board at *S* and *S'*.

The two methods shown in Fig. 3 and 4 result in types of curves which are not arcs of a circle. In the method shown in Fig. 4, a half circle is first drawn at the center line, using the amount of crown as the radius. Then the quarter circle is divided into any number of equal parts, and the distance from center line to sheer divided into the same number of equal parts. Parallel lines are then projected from the points on the circle, to intersect at right angles a series of parallel lines projected from the points on the half breadth. These points are connected with a bending batten to establish the curve.

The method shown in Fig. 3 will result in deck beams in which the curve is much greater at the sheer than at the center. This type of deck beam is used in some runabouts and racing boats, and often for the cabin beams of a cruiser. The half breadths and crown are each divided into the same number of equal parts and lines drawn as shown in the diagram. The lowest points at which these lines intersect are the proper points to be connected with a bending batten.

After the deck beams are laid out, they are cut to shape and the inside surfaces planed smooth. In some small boats they are fastened to the side frames before the boat is set up, but in most boats they are put in position after the boat is planked. They are fastened to the side frames, to the sheer batten, or, in some cases, to a longitudinal member called a clamp.

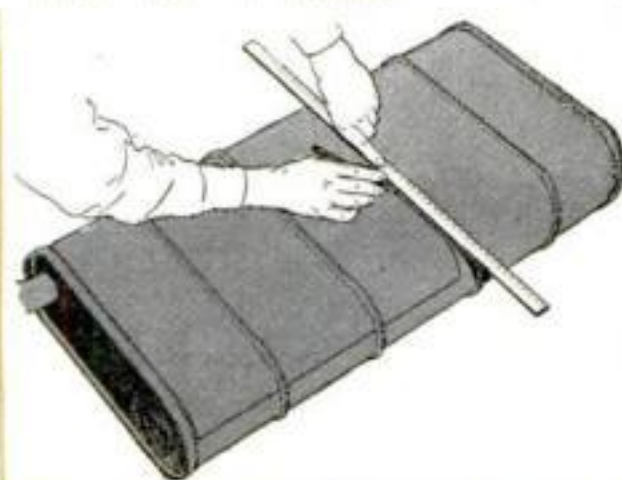
Finally comes the important job of truing up or fairing the outer surfaces of the beams. This has to be done almost entirely by eye, and much of the appearance of the finished boat will depend on how carefully it is done. A long light batten is a great aid in doing this. It must be laid or clamped in place lengthwise over the beams in many different positions. By sighting along it (as demonstrated in the photograph on the opposite page), any little unevenness or high spots are detected. These high spots are then carefully planed down, and

the operation repeated over and over until you are sure the entire surface on which the decking will be laid is perfectly faired.

Next month: How to construct a 19' cruising sailboat or cabin sloop.

Snow Shovel from Old Tank

NO METAL-WORKING skill is necessary in making this durable snow shovel. A section taken from an old gasoline tank of the flat-shaped type—obtainable at almost any auto junk yard—is cut to the dimensions shown and riveted to a handle made from oak or hickory.—FRANK WHELOCK.



Small Lathe Faceplates

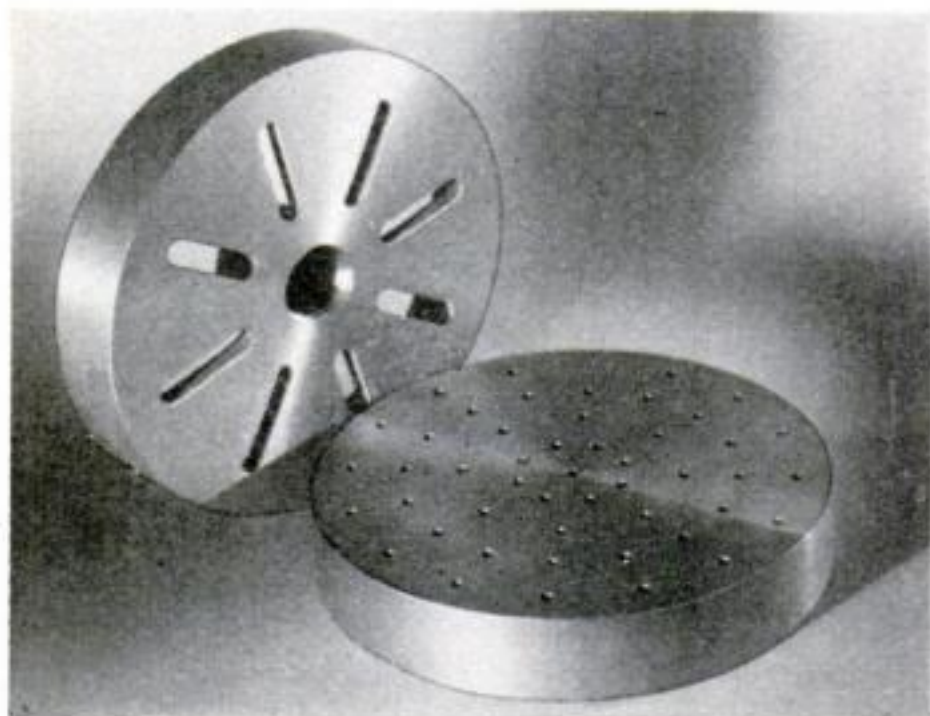


Fig. 1. Small faceplates like these find use in many types of work

By C. W. WOODSON

AMONG the countless projects the owner of a small precision lathe can make, nothing will be more useful than a set of faceplates such as those illustrated (Fig. 1). Most of the work, from turning the wooden patterns to machining the castings, can be done on the lathe itself.

The rough blanks for the wooden patterns can be cut from 1" thick stock as shown in Fig. 2, then mounted in the three-jaw chuck (Fig. 3) and turned to the dimensions given in the drawings. Allow $\frac{1}{8}$ " all around for machining. The center hole can be lightly indicated at a steep angle, but need not be drilled through.

The face of the pattern for the faceplate with the many holes can be left solid. In the pattern for the other plate, however, the slots should be cut. This can be done by drilling a $\frac{5}{16}$ " hole at each end of each slot and sawing out the stock between (Fig. 4). Have the jig-saw table slightly tilted to form the necessary bevel or draft on the sides of the slot so that the pattern can be withdrawn from the sand in molding. A similar draft is also needed on both sides of the outer flange, as well as on the col-

HOW TO MACHINE TWO TYPES FROM INEXPENSIVE GRAY-IRON CASTINGS

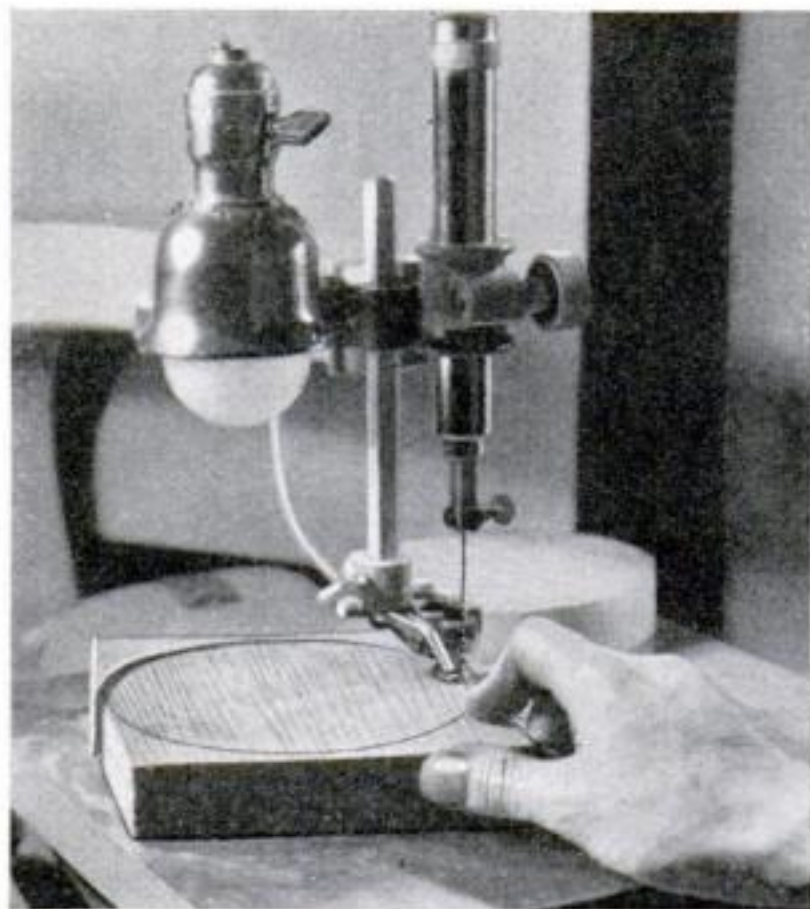
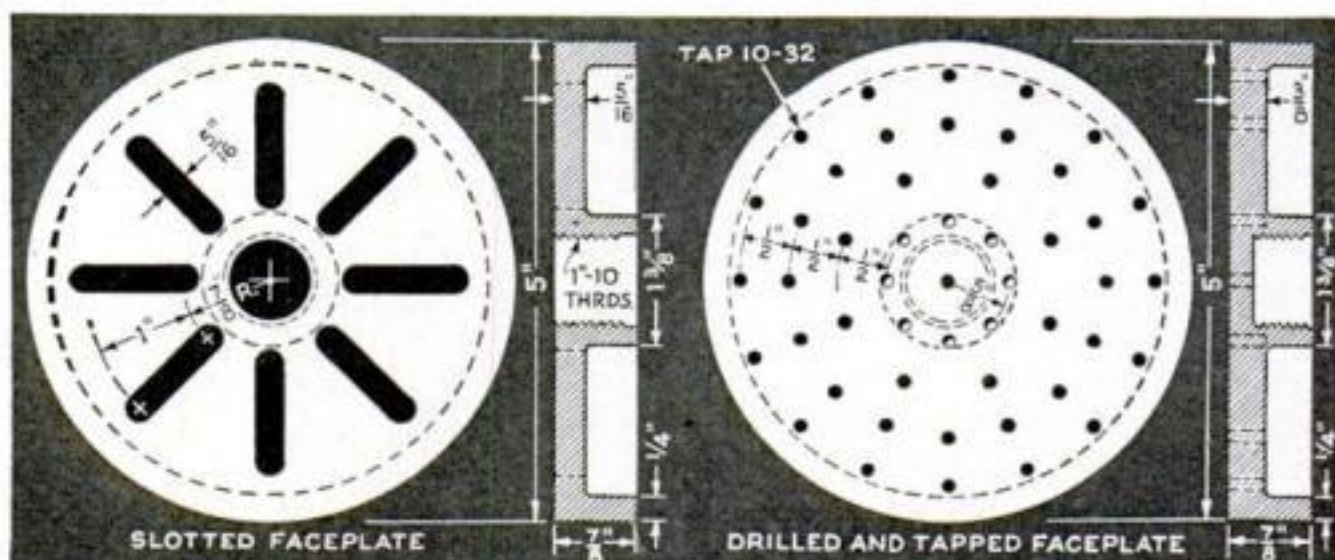


Fig. 2. Jig-saw the rough blocks for the two wooden faceplate patterns from 1" thick stock



Fig. 3. Mount pattern in lathe for turning



lar in the center of the faceplate pattern.

After these patterns have been well sanded and shellacked (Fig. 5), they are ready to be sent to a local foundry so that gray-iron castings can be made.

Machine work should be started on the slotted faceplate first, as this will be needed to hold the other plate while threading the center hole from the back. The casting is held in the three-jaw chuck while the center hole is threaded



Fig. 4. Drill a 5/16" hole at each end of each slot and jig-saw out the stock between

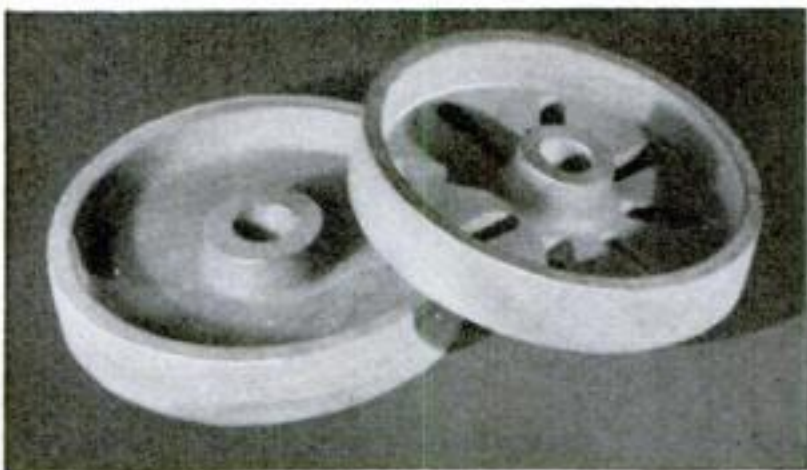


Fig. 5. Sand and shellac the patterns, then send to a foundry for casting in gray iron

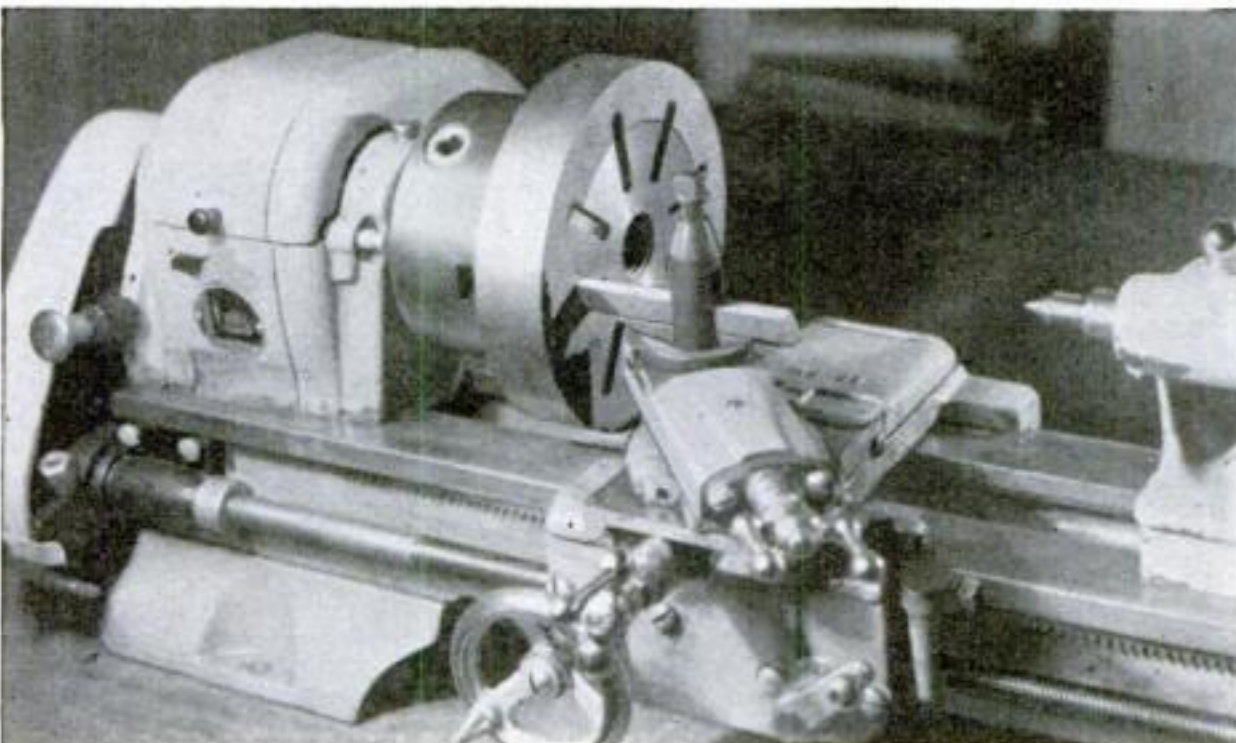


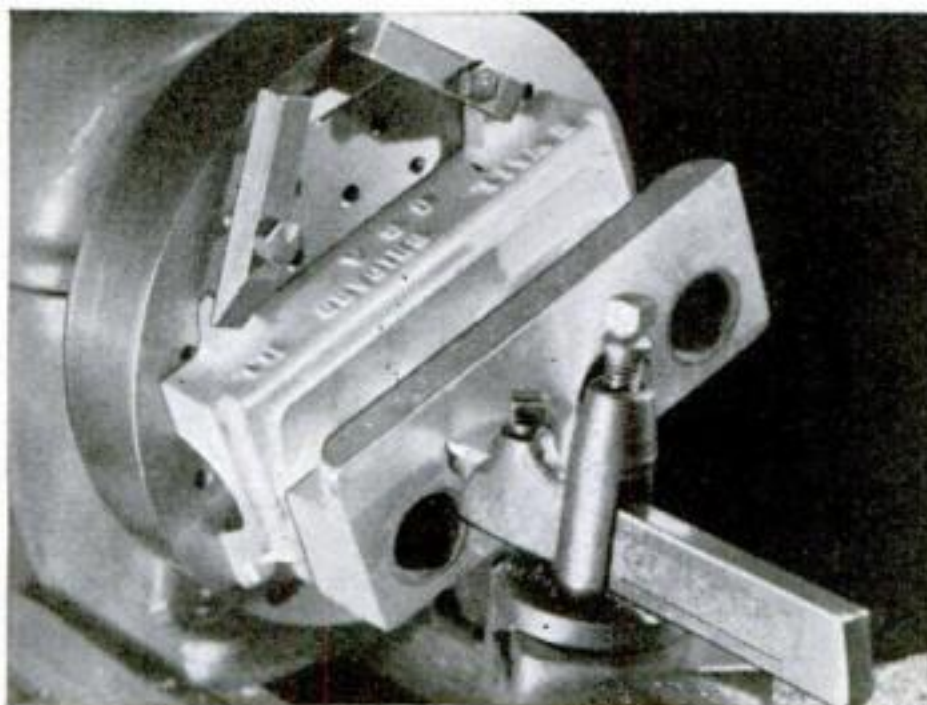
Fig. 6. Thread the center hole of the casting, and machine the face

to fit the spindle nose of the lathe. A facing cut is then made (Fig. 6), after which the work is removed from the chuck and screwed directly on the spindle nose. The back of the plate is finally turned true and smoothed all over to give a workmanlike finish.

It is a somewhat more difficult problem to machine the forty-nine hole faceplate because it is hard to chuck and the threaded hole does not go all the way through. Perhaps the best method is to fasten it on the already finished faceplate, face to face, by accurately locating, drilling, and tapping three of the forty-nine holes. Once the plate is mounted in this way, the inside can be machined all over and the center hole can be bored and threaded to fit the spindle nose.

The plate is next removed and screwed directly to the spindle so that the face of the outside of the flange can be turned to run dead true. The remaining holes are then drilled (Fig. 7) and tapped.

With the aid of various clamps, the faceplate may be used for mounting all sorts of awkwardly shaped work, such as that illustrated directly below.



The many holes simplify the mounting of awkward work

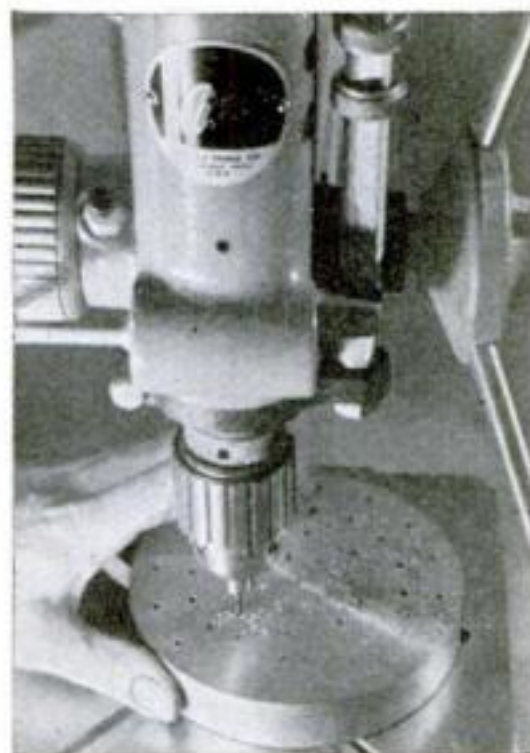
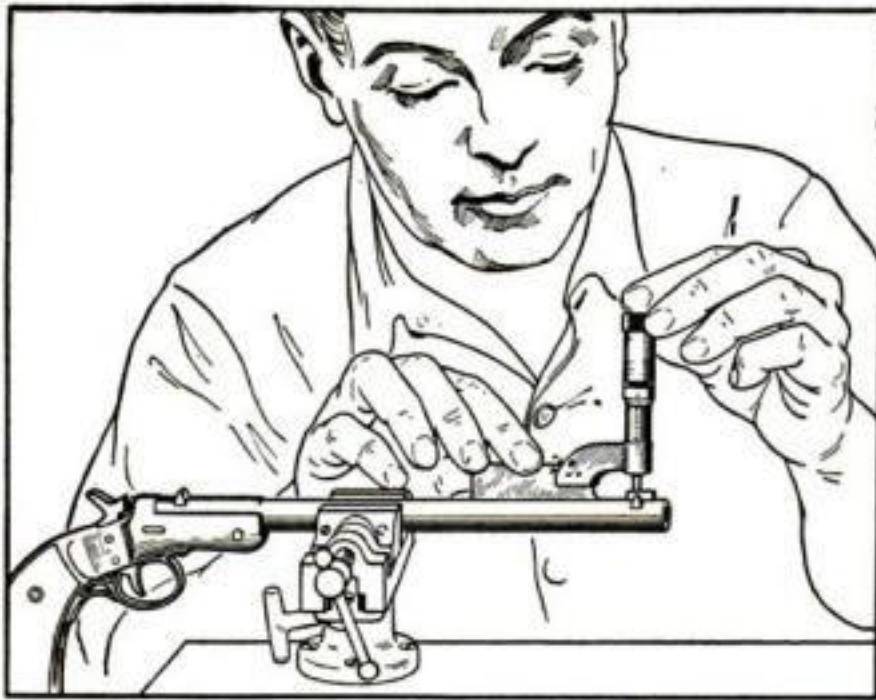


Fig. 7. Drilling the holes

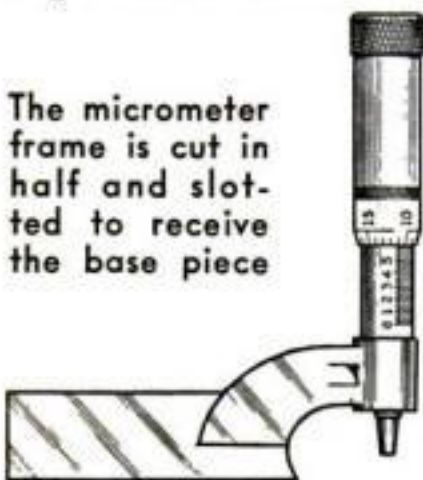


Old Micrometer Converted into a Special Gauge

FOR certain types of precision work in the shop, a useful height and depth gauge may be made from an old 1" micrometer. One use of the tool, for example, is checking the height of gun sights.

The frame of the micrometer is cut as shown, and a base added by soldering a piece of steel in a slot sawed into the frame. A soldered joint is secure enough, as a tool of this type is not subjected to any abuse. The base is set so that 0.500" on the scale represents zero. Measurements may be

The micrometer frame is cut in half and slotted to receive the base piece

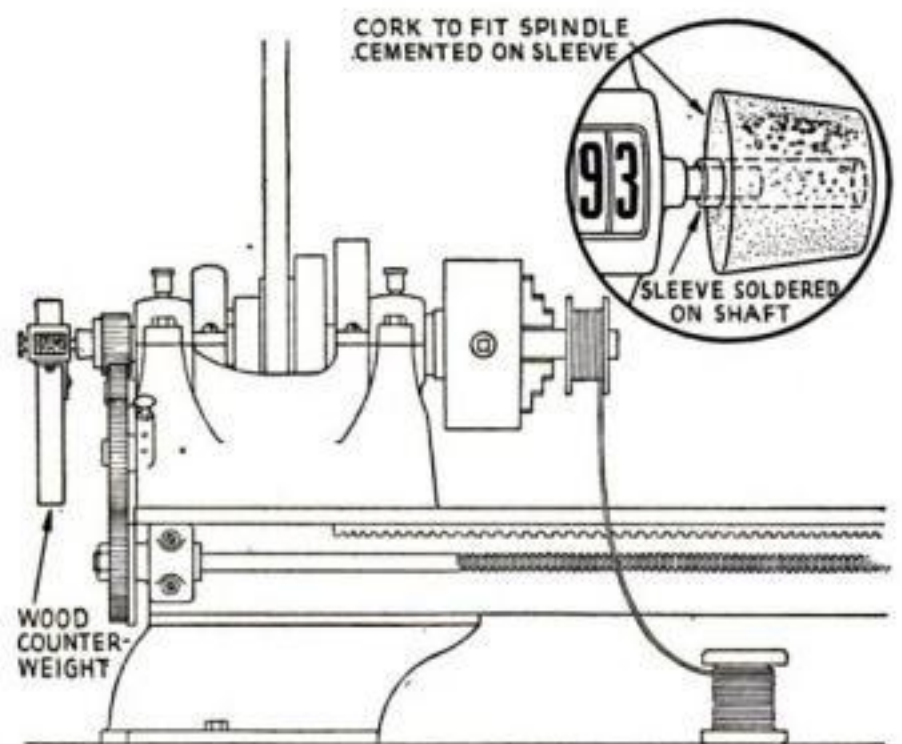


made from $\frac{1}{2}$ " above to $\frac{1}{2}$ " below zero. Other arrangements are possible to suit special needs; for instance, the gauge might be adjusted so it reads up to 1" high or 1" low.—M. L. B.

Coil-Winding Counter Made from Bicycle Odometer

WHILE winding some transformer coils, it occurred to me that a simple turn counter could be made from a small bicycle odometer I had and thus save me a lot of time in keeping track of the turns. First, I screwed the unit to a piece of wood about 6" long and 1" square. This serves as a counterweight to prevent the counter from turning. Then I found a cork to fit in the lathe headstock spindle and mounted the counter as shown below.

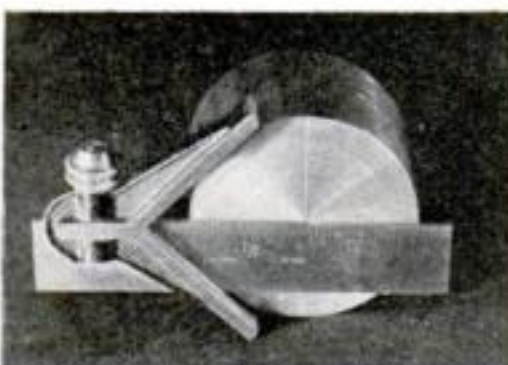
Before starting to wind, I note the number on the counter; it is not necessary to turn to zero each time. If the wire should wind back over itself or become kinked, the lathe is merely reversed, and the counter then subtracts automatically, thus insuring an accurate total.—R. H. MCNAIR.



The counter is mounted by means of a cork, and the wooden counterweight keeps it from revolving

CENTERING LATHE WORK

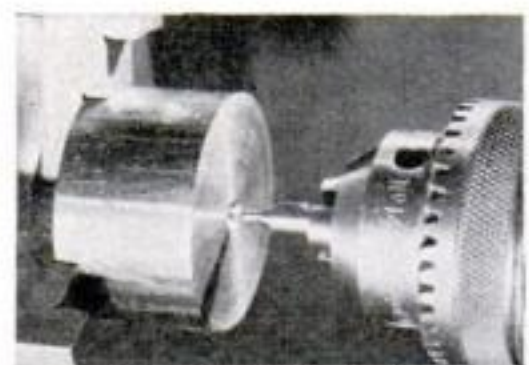
[LATHE WORK—5]



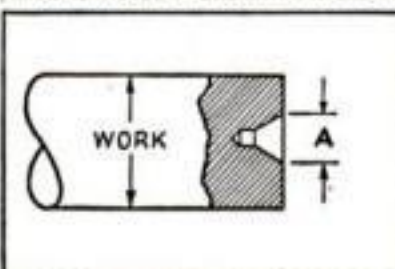
LOCATING CENTERS WITH A CENTER HEAD



PUNCHING THE CENTER POINT



COUNTERSINKING CENTER HOLE



COMB. DRILL & COUNTERSINK	DIAMETER OF WORK	COUNTERSUNK HOLE DIA.-A	DIA. OF DRILL-D	DIA. OF BODY-B
No. 1	$\frac{3}{16}$ " TO $\frac{5}{16}$ "	$\frac{1}{8}$ "	$\frac{1}{16}$ "	$\frac{13}{64}$ "
No. 2	$\frac{3}{8}$ " TO 1"	$\frac{3}{16}$ "	$\frac{3}{32}$ "	$\frac{3}{10}$ "
No. 3	$1\frac{1}{4}$ " TO 2"	$\frac{1}{4}$ "	$\frac{1}{8}$ "	$\frac{3}{10}$ "
No. 4	$2\frac{1}{4}$ " TO 4"	$\frac{5}{16}$ "	$\frac{5}{32}$ "	$\frac{7}{16}$ "



COMBINATION DRILL AND COUNTERSINK

Sandpaper Fastened to Disk with Rubber Cement

WHITE rubber cement offers a quick, reliable, and care-free method for attaching fresh sandpaper to sanding-machine disks. For best results, the cement should be thin enough to flow smoothly under the brush. For thinning, only pure benzine should be used.

The disk must be perfectly free of dirt, grease, and old adhesive. One coat of cement on the disk and one coat on the back of the sandpaper is all that is necessary. Allow each coat to set for about five minutes and then press the disk and paper firmly together. Tap the paper into intimate contact by means of a mallet or flat block of wood, and trim the edges.

When the paper is worn out, loosen the edge with the point of a knife and strip the whole sheet off.—K. C.



Lye, Soda, and Potassium Permanganate Remove Rust



ALTHOUGH not as speedy as a solution of ammonium citrate, so often used to remove rust from tools, the following mixture is a satisfactory one, and the ingredients are readily obtained. Dissolve a cup of ordinary lye and half a cup of washing soda in a quart of water, and add about half a teaspoonful of potassium-permanganate crystals. After the rusty tools or other metal parts have been allowed to soak, the loosened rust is removed with a stiff brush.

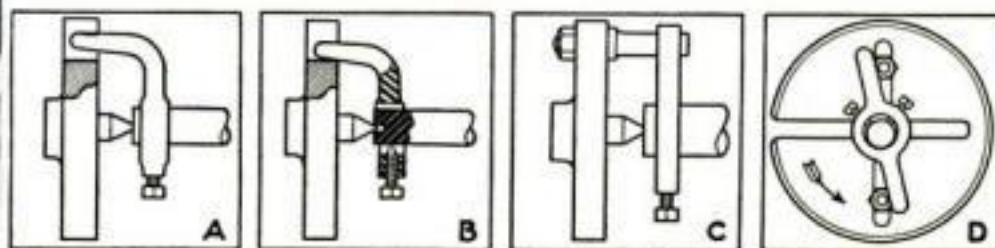
LATHE DOGS

[LATHE WORK—6]

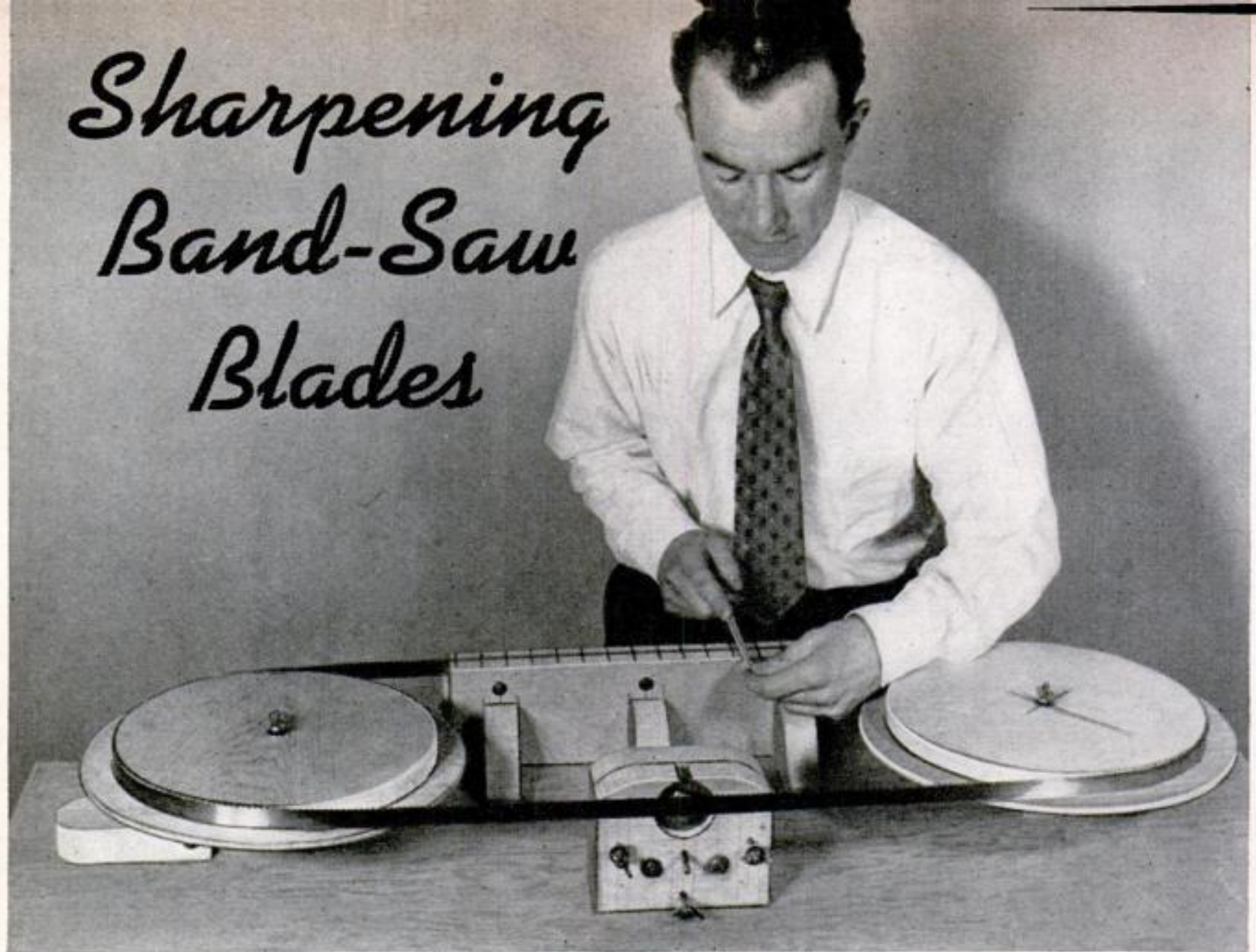
Proper mounting of the lathe dog or carrier for driving work held between centers is shown at A. The bent tail of the dog must fit loosely in the faceplate slot. If the dog is too small, the tail will bottom in the slot as shown at B, holding the work away from the live center and preventing it from running true. The straight-tailed dog C, driven from a pin in the faceplate, has less tendency to spring the work than the bent-tail type. The two-tailed dog D is driven by two pins; it has better balance and no tendency to spring the work. Adjust the pins carefully.



LARGE WORK DRIVEN BY CLAMP-TYPE DOG

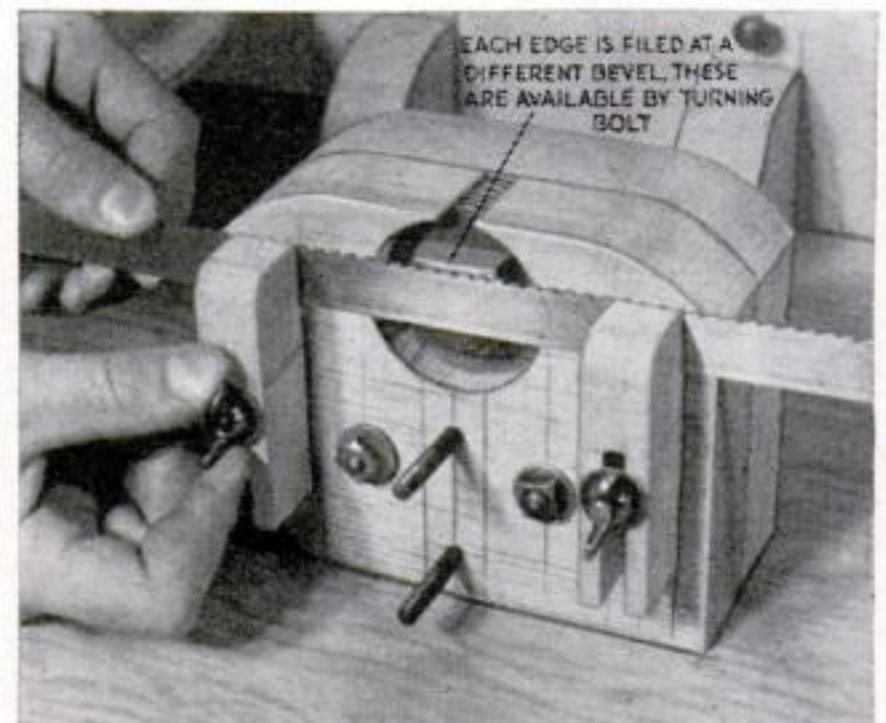
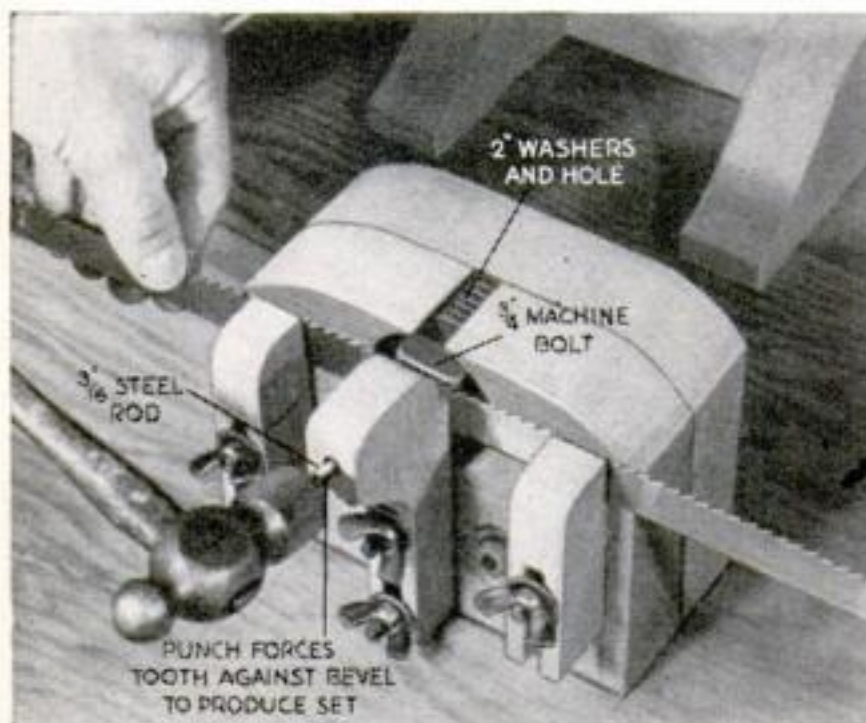


Sharpening Band-Saw Blades



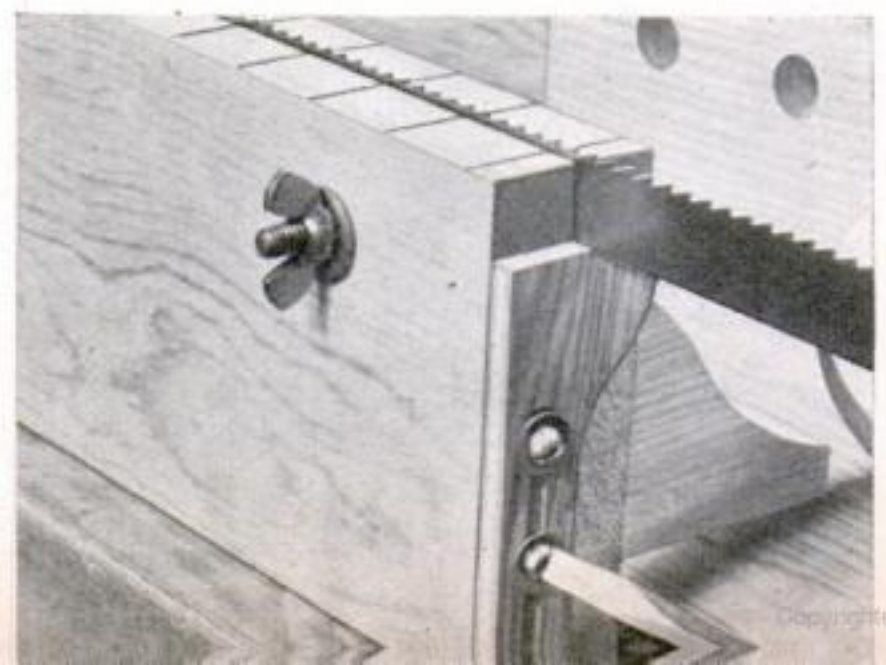
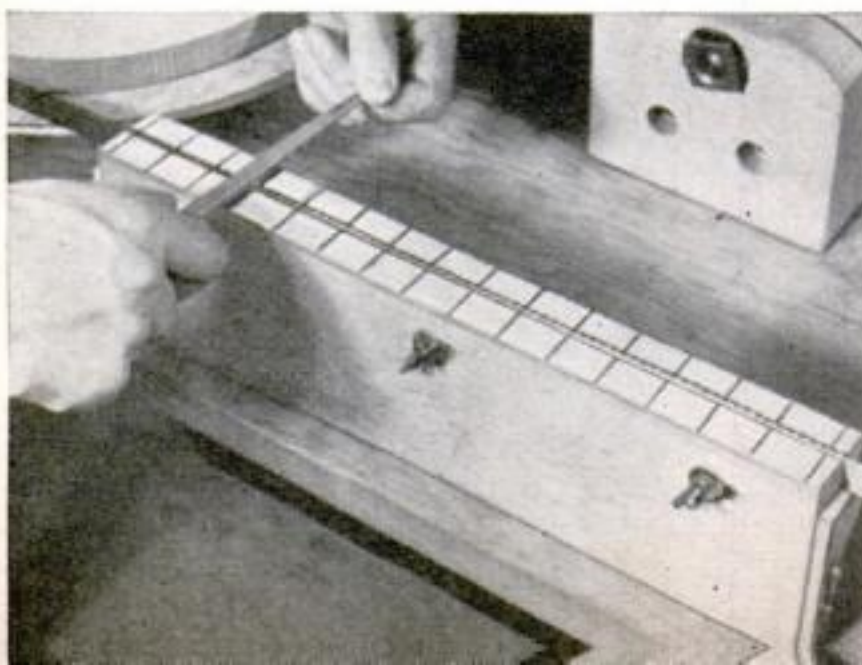
Above, the assembled sharpening outfit. The wheel centers are about 28" apart. First, joint the teeth with a fine oilstone before removing blade from

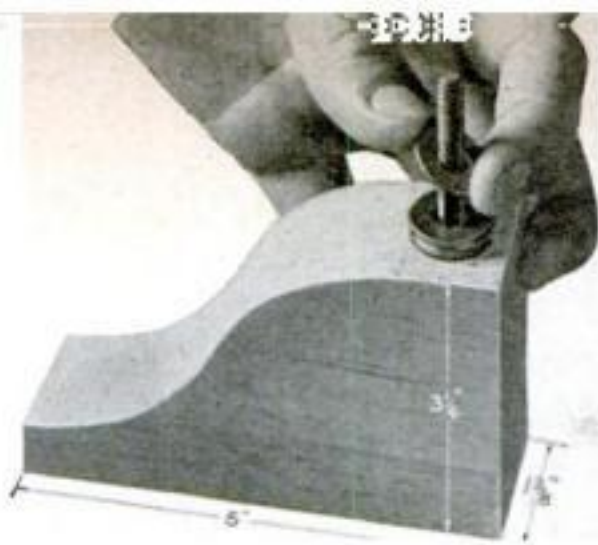
band saw. Then place it in the jig, as below, adjust for correct height, and punch every other tooth. Turn the blade inside out and set remaining teeth



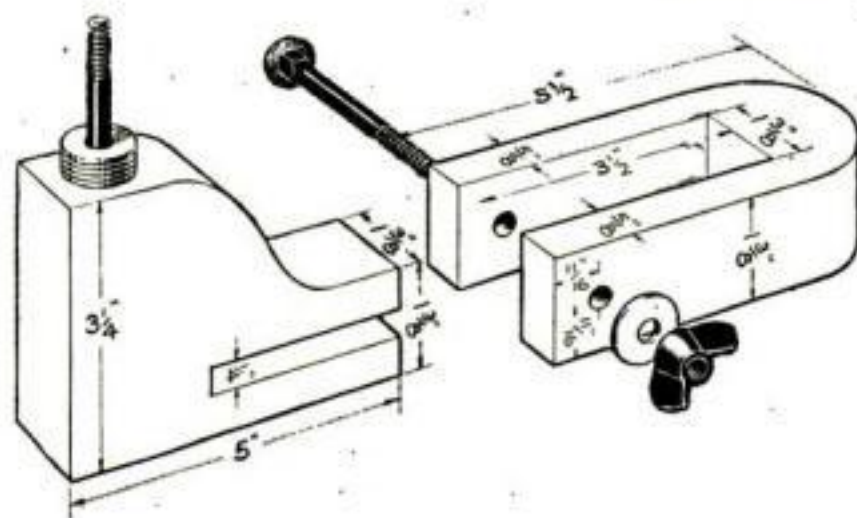
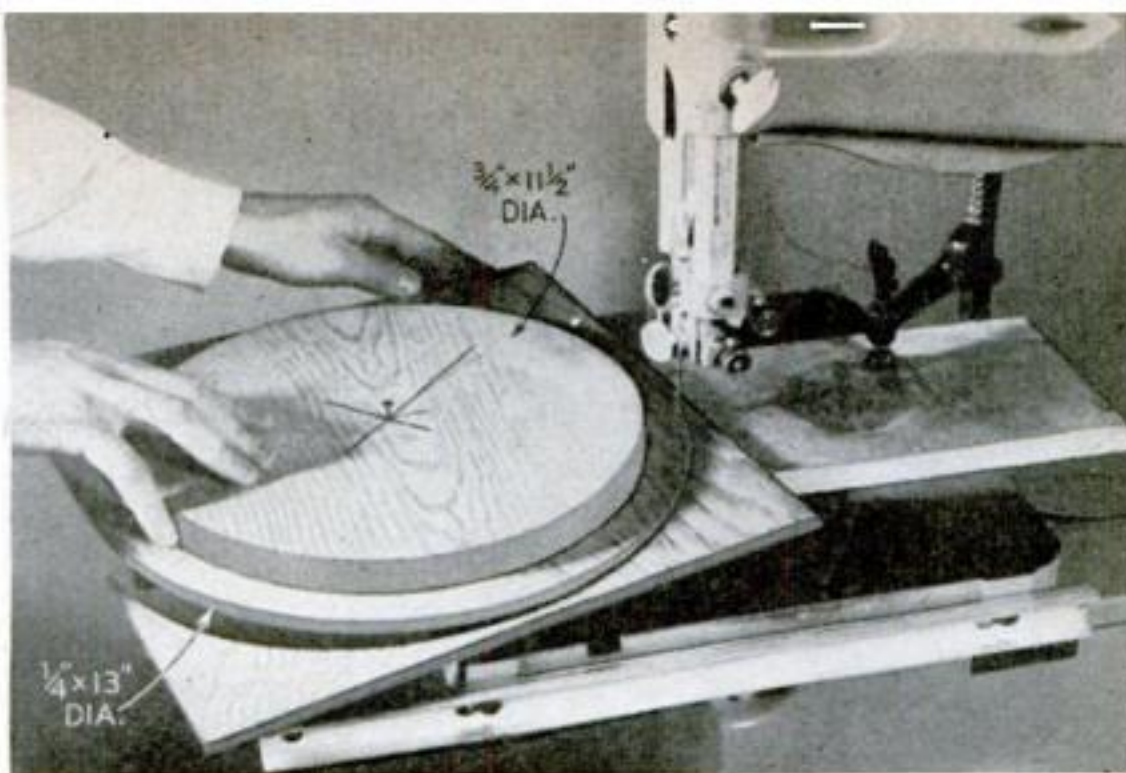
Below, two views of the filing vise. Guide lines aid in filing the teeth straight across. Note the

plywood pieces at each end of the jig, which can be adjusted so that only the blade's teeth stick up

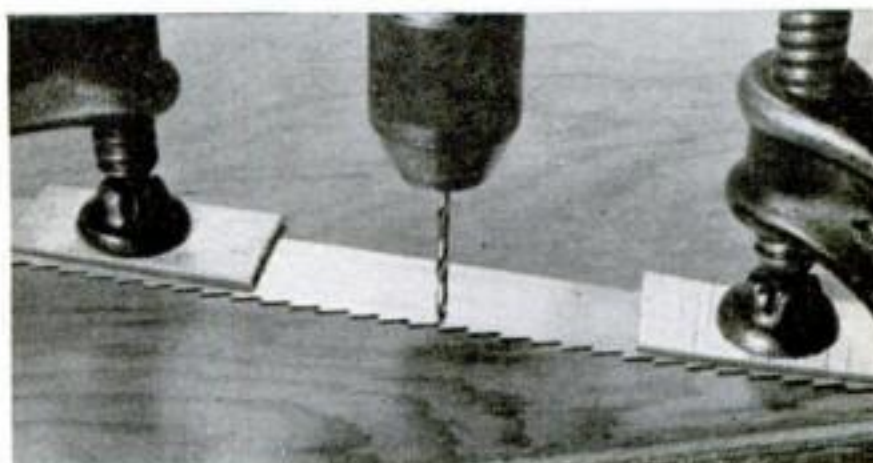




Heights of the stationary (above) and adjustable (below) wheel supports are increased by washers. At right, cutting the wheel and flange

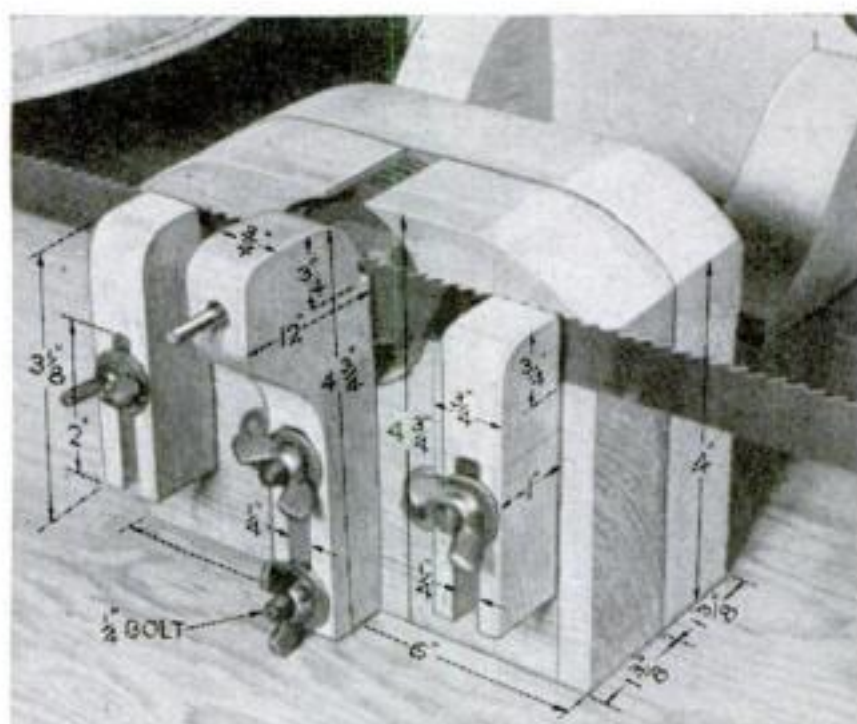


Scraps of lumber can be used to make the setting jig shown below and on opposite page. The height of the blade is adjusted by the vertical supports

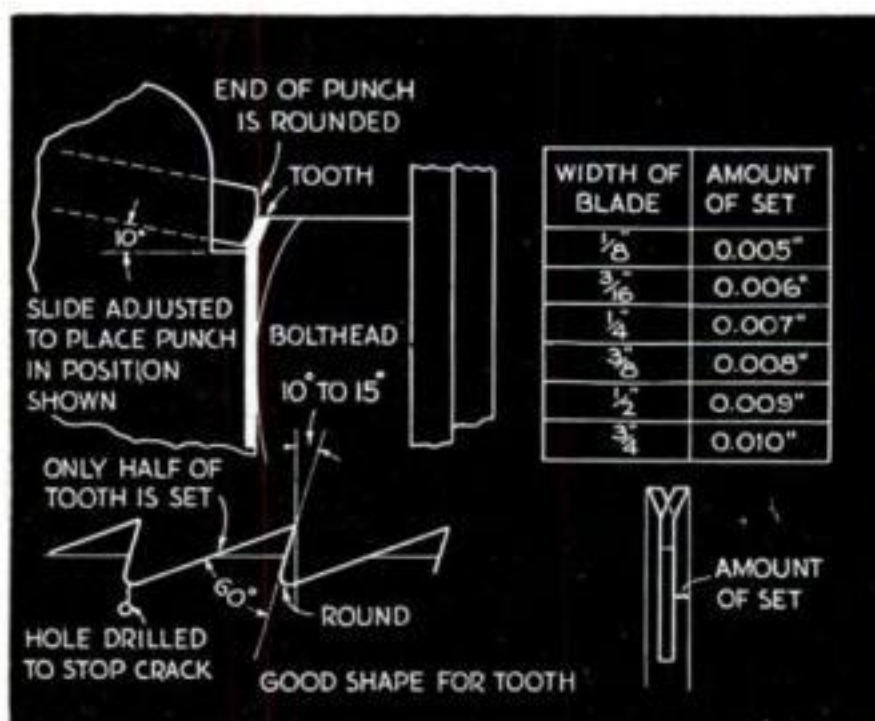


To stop a crack in a blade, drill a small hole. If the crack is bad, break the blade and have it re-brazed. Always do this with very narrow blades

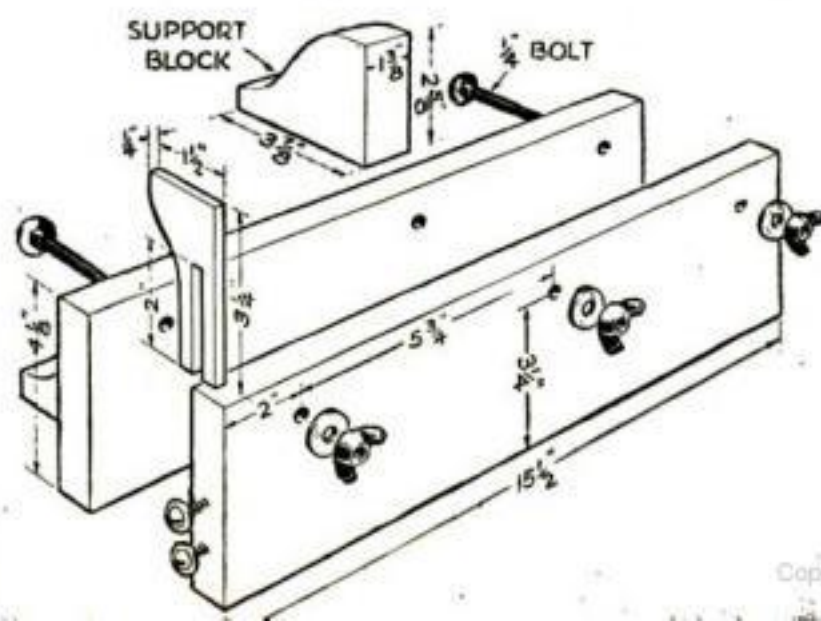
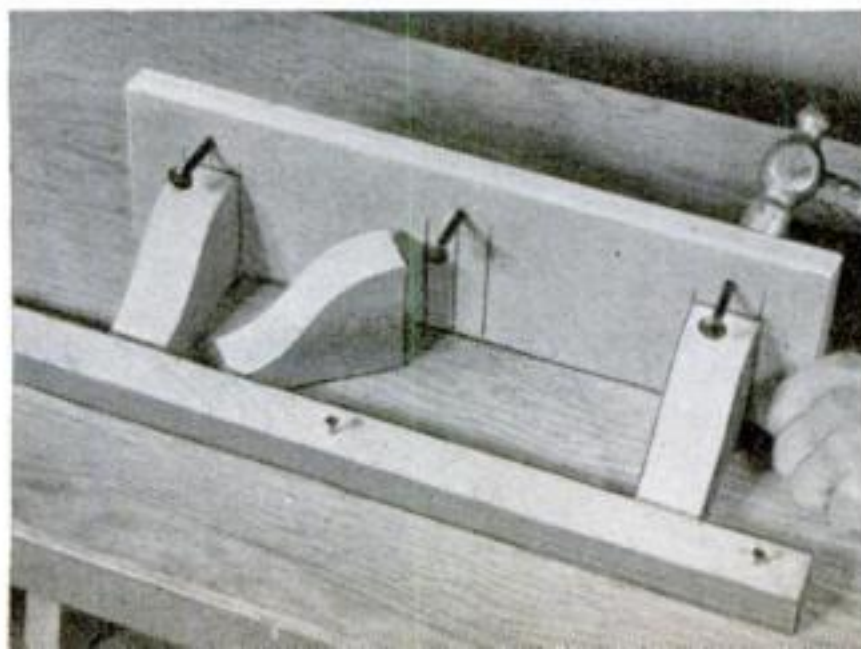
How to set the teeth, and a filing guide to use if blade is so worn the shape cannot be seen



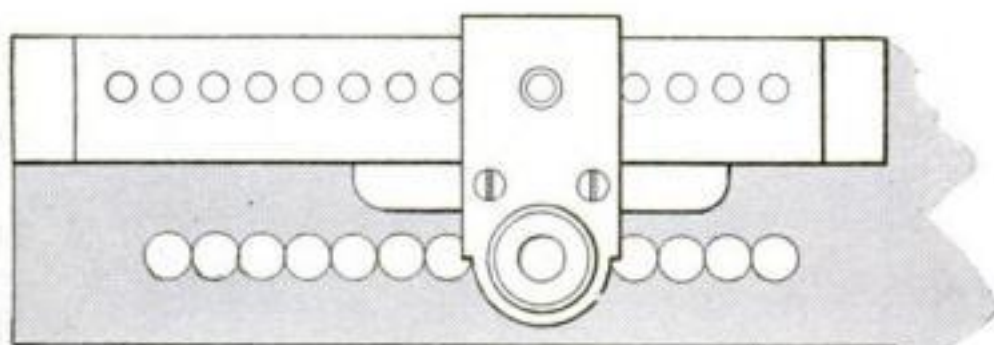
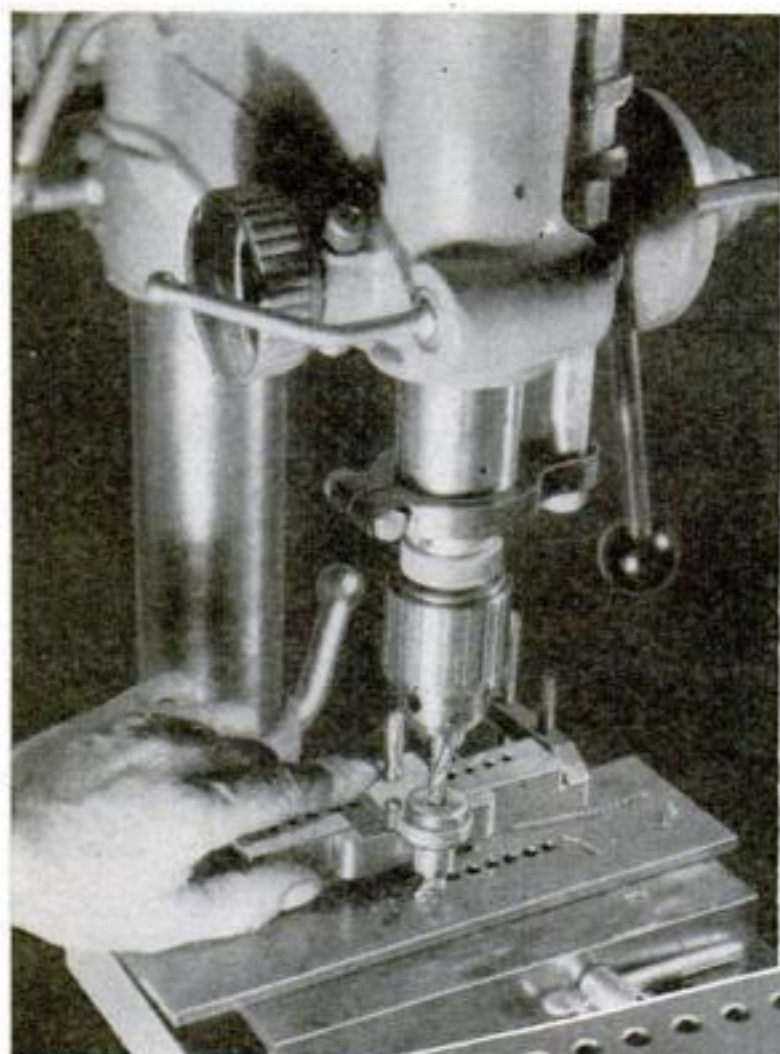
To nail the three support blocks to the back of the vise, brace them against a wood strip temporarily



fastened to the bench, as below. Complete all the parts and attach them to plywood 1/4" by 18" by 48"

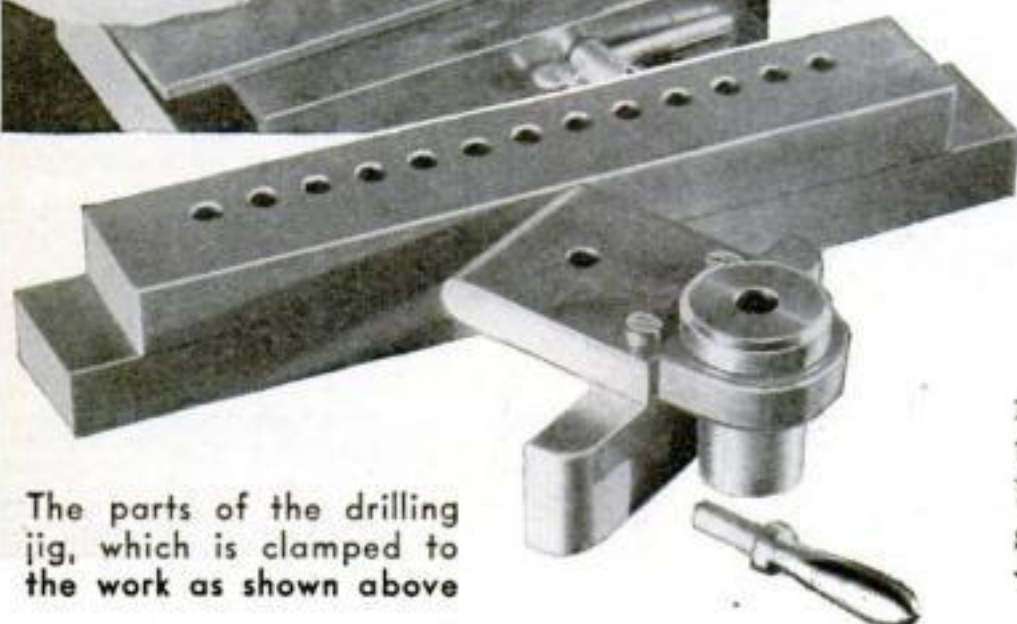


Overlapping Holes Drilled with Aid of Simple Jig



The sliding member of the jig holds a standard drill bushing and is located with a locking pin

THE difficult task of drilling closely spaced or overlapping holes can be accomplished easily with the aid of a drilling jig made up from steel stock as shown in the drawing above. This takes standard drill bushings of various hole sizes. The jig is clamped to the work, and the required bushing moved from hole to hole and accurately located with the locking pin. One photograph shows the jig being used to drill a row of evenly spaced holes. Overlapping holes can be drilled by increasing the size of the drill bushing and drill. The jig, of course, can be made any size desired.



The parts of the drilling jig, which is clamped to the work as shown above

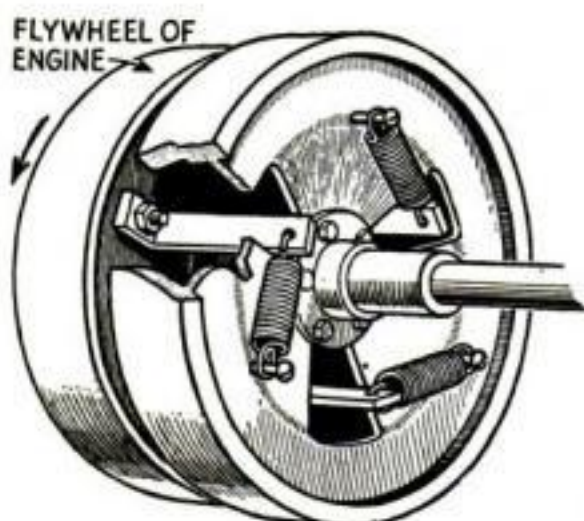
Tape Fastens Soft Vise Jaws

CHEAP and efficient safety jaws for a machinist's vise may be made by attaching friction tape to strips of cardboard, lead, or brass. The tape strip should be about $\frac{1}{4}$ " longer than the vise jaws.—FRED STRICKLAND.

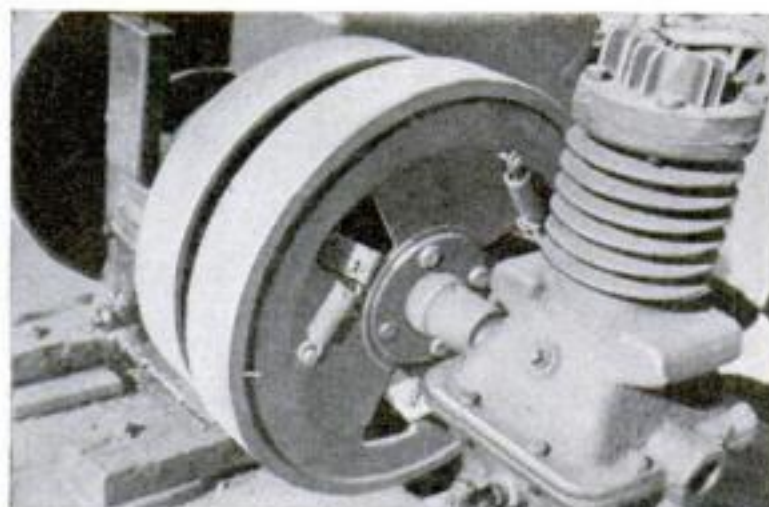
Compact Flexible Coupling Joins Two Machine Units

Two units of machinery, such as a gasoline engine and an air compressor, can be flexibly coupled by the method illustrated below. It enables them to be mounted much closer together than would be possible with most ordinary arrangements. Other advantages are that it eliminates any jerking and is less noisy than a belt or universal-joint hook-up.

Either two or three strips of iron, bent L-shape, are bolted to the flywheel of the engine, with one arm of each L at right angles to the wheel. This arm extends through an opening in the flywheel of the compressor and



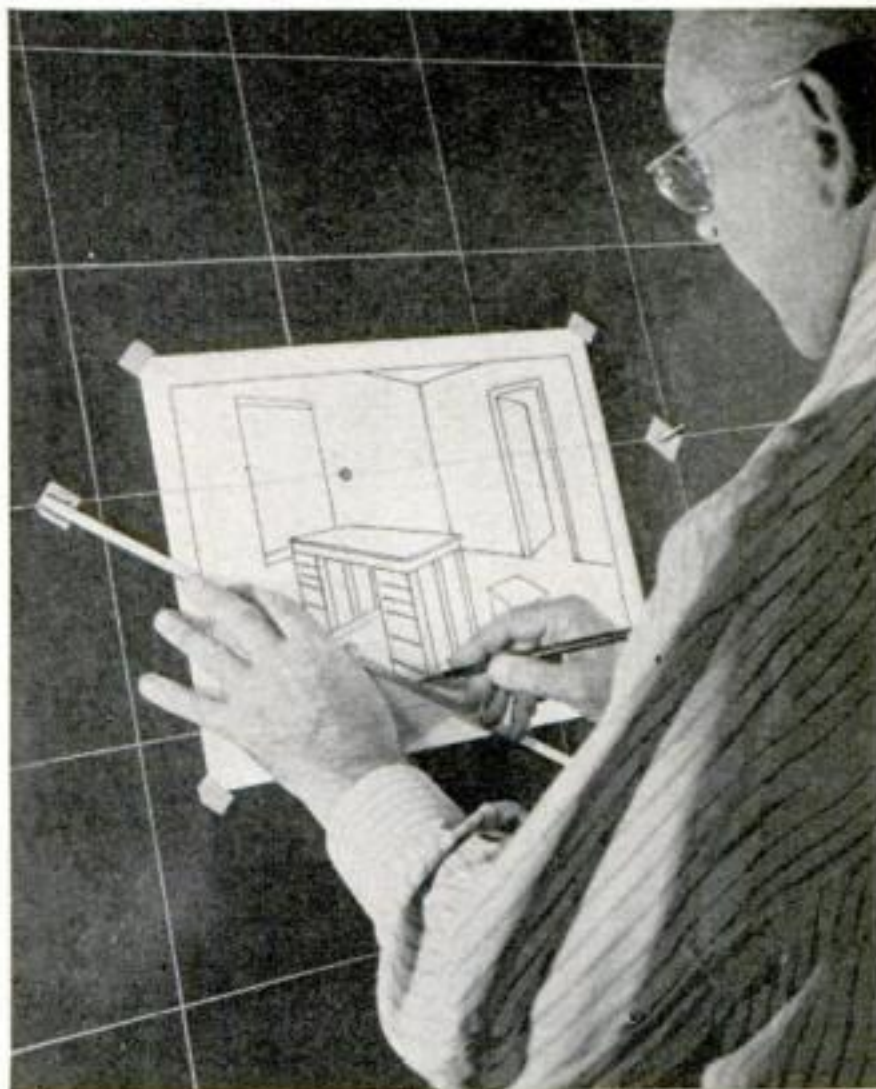
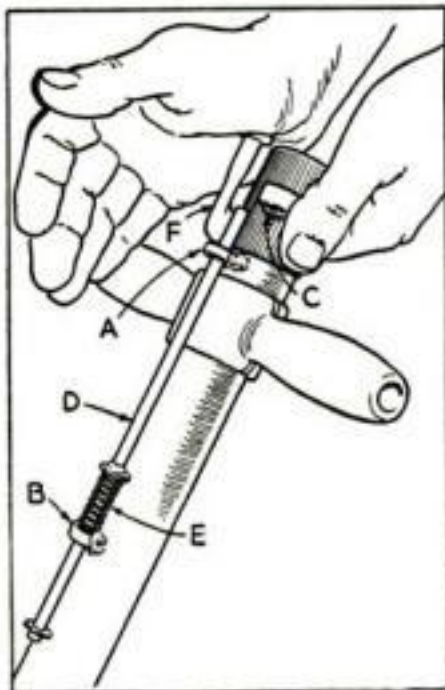
drives against it. A spring is stretched between each driving arm and a point on the compressor flywheel, exerting force in the direction the wheel turns. The purpose of the spring, of course, is to prevent the jerking action which would otherwise occur and which might prove damaging to the machine in the long run.—J. PHILIP LA POINT.



Lock Prevents Accidents with Garage Jack

IN USING a garage jack with a handle of the type shown, accidents have happened because some workman has accidentally struck the knurled nut on the end and thus let the jack down. By adding a lock as shown, a mishap of this kind becomes impossible.

Two small rings *A* and *B* are spot-welded on the jack handle, and another ring *C* is similarly fastened to the release nut so as to align with the other rings when the nut is turned to lock the jack. The rod *D* passes through the rings and is actuated by spring *E*. An offset handle *F* with a knob on the end enables the rod to be pushed down, and this must be done before the nut can be released.



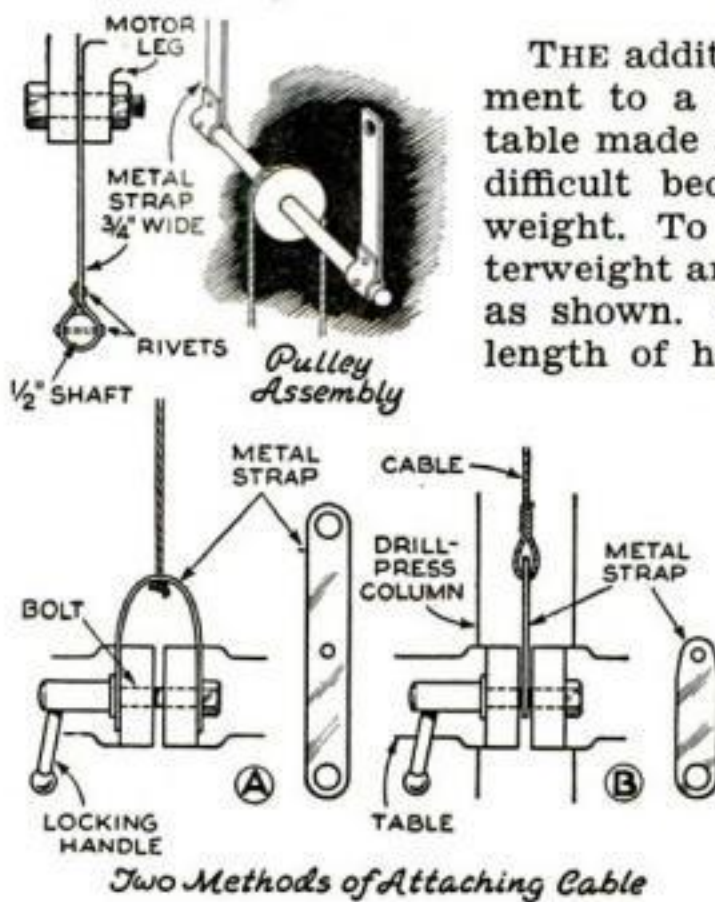
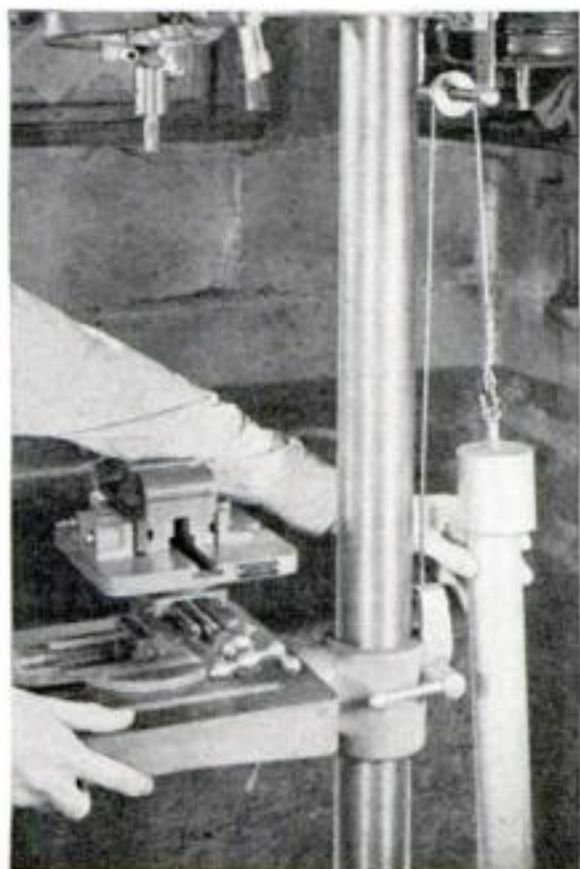
Thumb Tacks, Points Up, Aid in Drawing Perspectives

HANDY vanishing-point stations for illustrations or mechanical drawings can be made by sticking a thumb tack, point up, through a small bit of masking tape or transparent cellulose tape. This tape, if left on only temporarily, will not injure good drawing paper. Other tacks stuck on the drawing board in this way will support rulers and triangles.—L. A. L.

Oiling Out-of-the-Way Bearings

A LENGTH of windshield-wiper tubing or other tubing attached to the spout of an oil can will direct the oil to bearings of motors which are located in awkward out-of-the-way places.—C. L. S.

Counterweight for Heavily Loaded Drill-Press Table



THE addition of a milling attachment to a floor-type drill-press table made adjustment of the table difficult because of the increased weight. To overcome this, a counterweight arrangement was devised as shown. The weight is a scrap length of heavy steel shafting. It

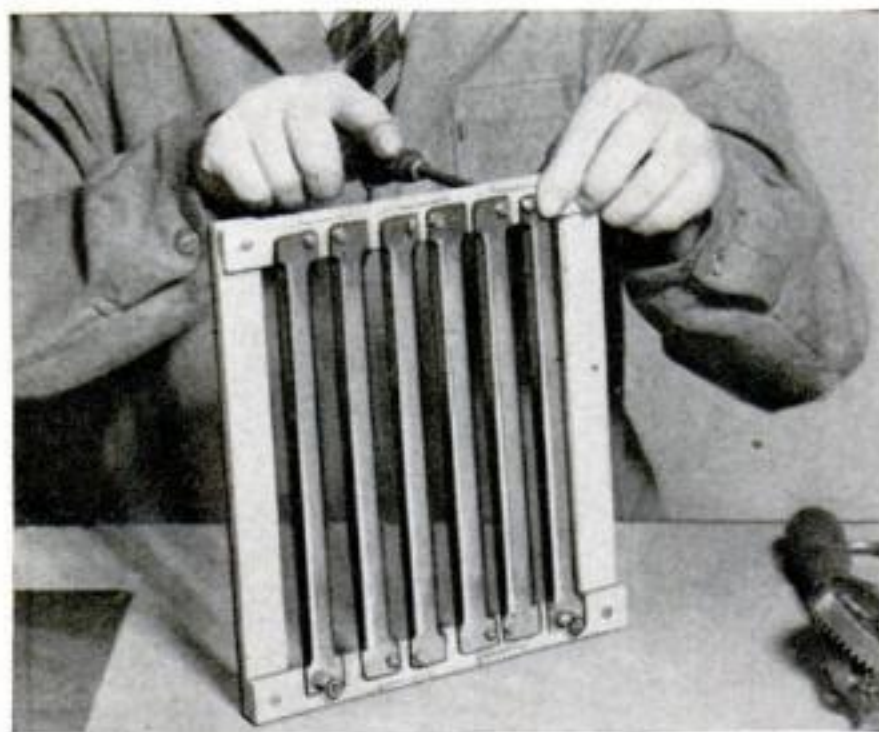
hangs on a length of flexible steel cable which runs over a pulley mounted on a stationary shaft. The pulley should be oiled occasionally. Either of the methods illustrated may be used for attaching the cable to the drill-press table.—W.E.B.

Electric Heater

USES BUILT-IN FAN
TO SWIRL WARM AIR
THROUGHOUT A ROOM



Stretch the nichrome wire across a frame of asbestos board, fitting the turns into saw slots



Attach shields in back of the coils to protect them from the chilling effect of the small fan

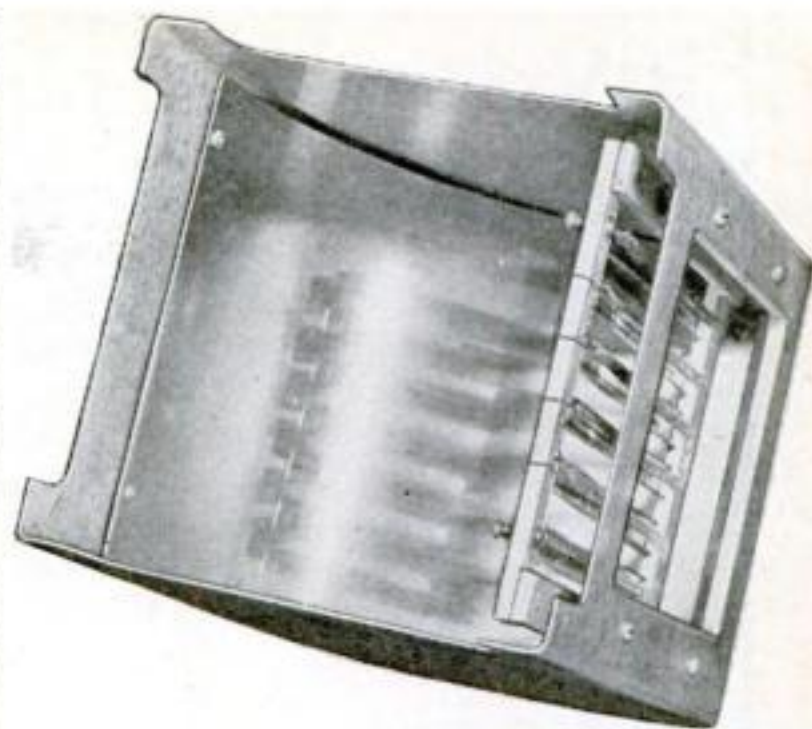
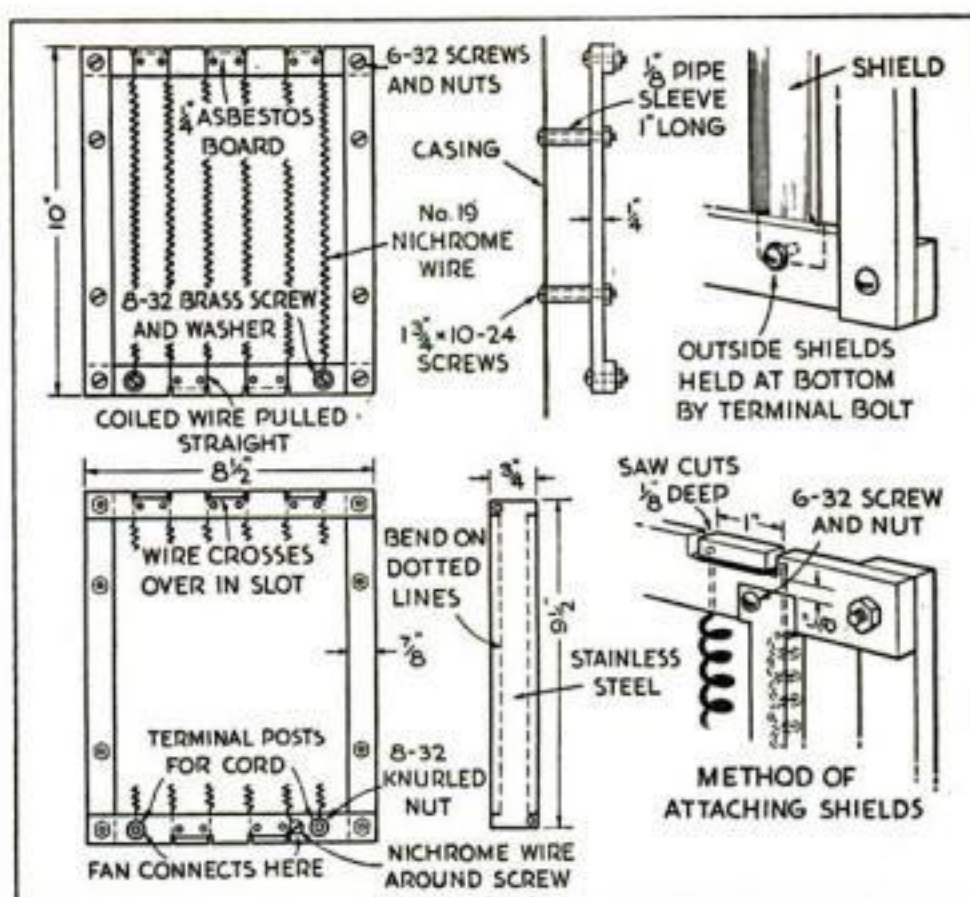


CIRCULATED by means of a small fan, hot air from this electric heater rapidly fills a room, providing extra warmth where needed. Materials required are 1 pc. 28-gauge galvanized iron 19" by 38½", 1 pc. ¼" asbestos board 10" by 20", an inexpensive electric fan, 8' of No. 16 asbestos heater cord, a rubber cord attachment cap, a small toggle switch, 1 pc. 26-gauge stainless sheet steel 10" by 18", 23' of No. 19 nichrome resistance wire, hot-pipe aluminum paint, wire from coat hangers, 4 pc. ⅛" pipe 1" long, and miscellaneous screws and rivets.

First construct the frame of asbestos board. Wind the nichrome wire closely on a 3/16" arbor or rod to make a coil about 13" long. Then carefully pull it open to provide six coils that just span the distance between top and bottom members of the frame. Straighten the wire at five places to pass around the saw cuts as indicated. Stretch the coils so they will not sag later and touch the shields. The wire ends terminate at binding posts, which consist of 8-32 brass screws, nuts, washers, and knurled nuts taken from an old dry battery.

Now attach the shields, making certain they do not touch the resistance wires at any point except at the two lower ends where the binding post screws pass through them. These shields give added efficiency to the heater because the air cannot blow directly on the hot wires and cool them. Instead, the air passes between the shielded coils.

Cut the outer casing from 28-gauge galvanized iron or steel. Fold carefully over a hardwood plank, using a flat piece of wood rather than a hammer to form the square corners. Use small bolts to hold the top seam together, and rivets along the curved joint. The joints can be brazed or welded if



Inside view of casing before a small fan is installed. Note the stainless-steel reflector

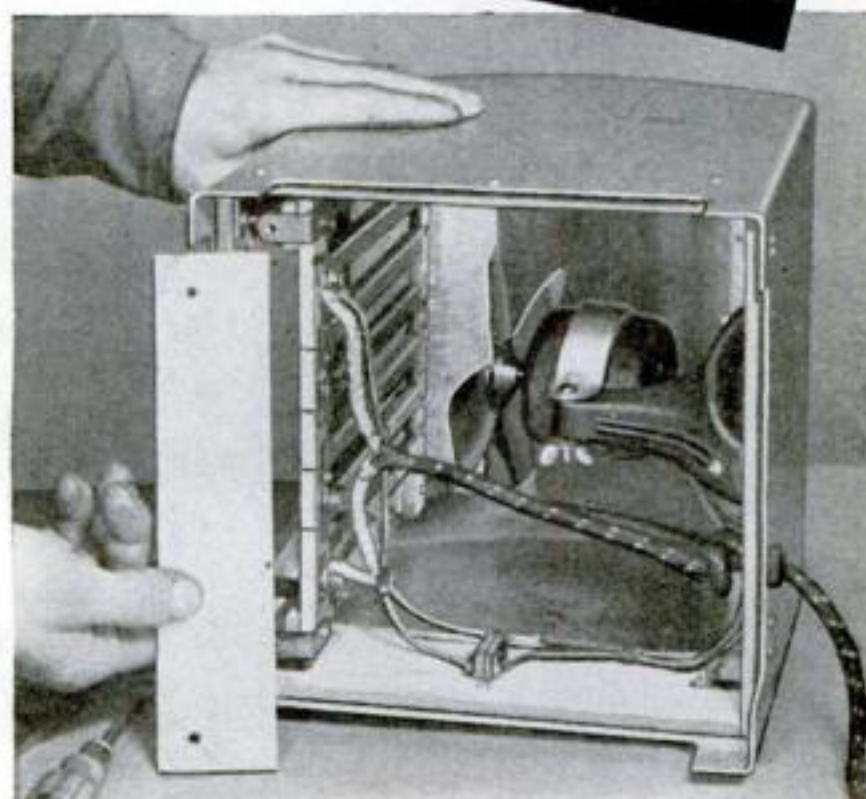
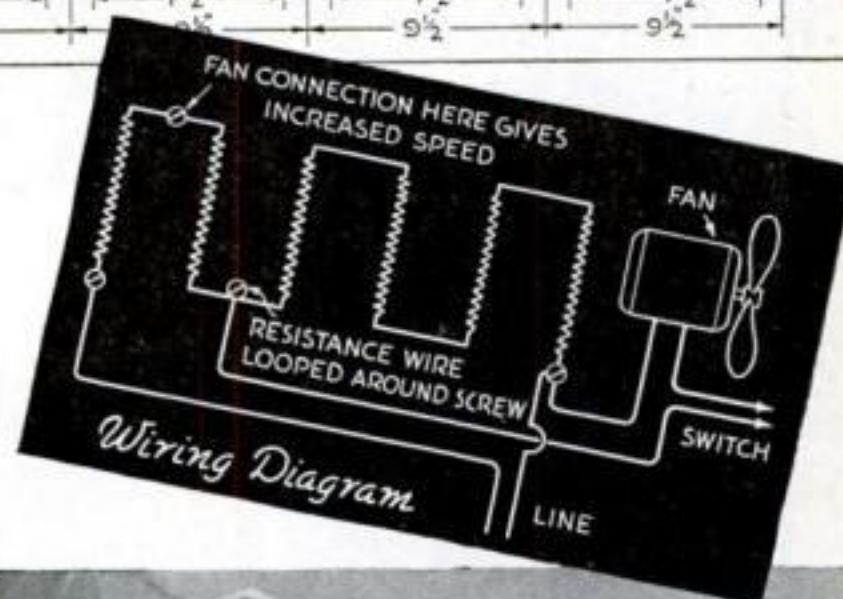
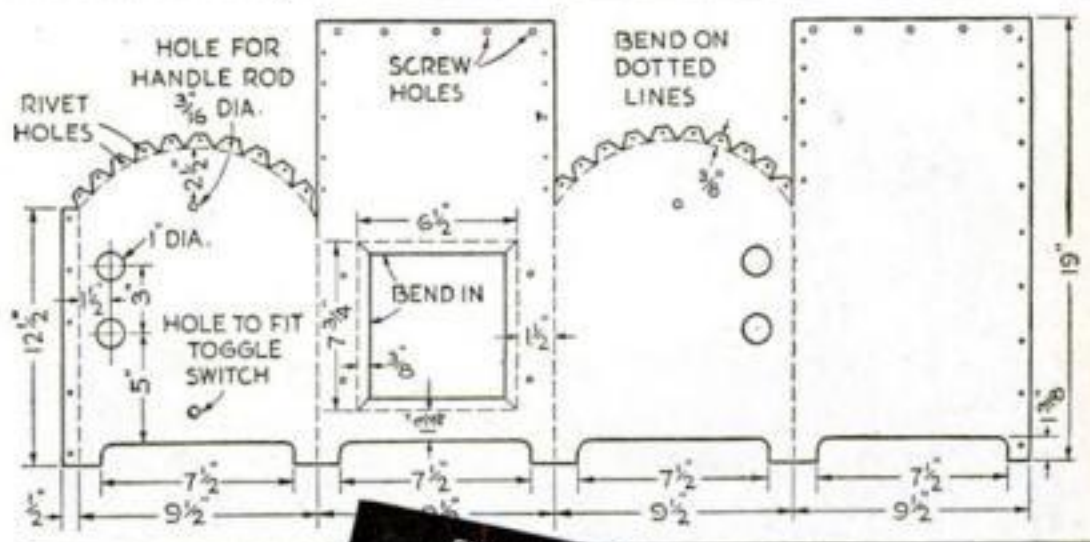
suitable equipment is at hand.

Insert a polished stainless-steel reflector and install the resistance unit by means of four long machine screws and nuts, with 1" spacers cut from $\frac{1}{8}$ " pipe to keep the unit back from the front casing. This installation is shown in one of the photographs.

The fan illustrated was purchased in a chain drug store for \$1.19. Any small fan will do, but cut down the blades so they are no more than 3" from center hole to end of blade.

The completed heater, as seen from the bottom, is shown in the lower right-hand photograph. Some of the asbestos board has been used to line the casing to increase its rigidity and improve its fireproof qualities. The fan has been bolted to the back, and No. 16 asbestos cord brought in through a porcelain bushing and connected to the terminal posts. The fan wires, with heat-resisting insulation, can also be seen, one going to the toggle switch and the other connecting to its special binding post. The asbestos board held in the hand serves as a cover to inclose the live connections and keep heat from radiating toward the floor.

Make a handle from heavy wire with a wooden turning in the center. Shape guards from wire coat hangers and attach in front. Only two are shown, but more should be added if children are about. Coat the casing with aluminum paint of the type used for hot pipes. This can be applied with a brush, but a better finish is obtained with a spray gun. If the heater is to be left on for any length of time, place a piece of asbestos board underneath for added fire protection.—HAROLD P. STRAND.



Easy Tests Demonstrate Mysteries of Astronomy

CAPTURED by the sun's gravitation, Halley's comet periodically reappears. Other comets whiz past, never to return. Why? With an animated model, you can reproduce their orbits on a miniature scale, in one of the neatest little experiments on these pages. Simple stunts for home experimenters also explain the phases of the moon; how you can measure its diameter;

the method astronomers use to gauge the distance of celestial objects; and the mysteries of a total eclipse.

Of what use is such lore? Navigators of air and sea set their courses by the sun and stars. Government stargazers give us the right time. Knowledge of solar eclipses has made it possible for historians to fix accurate dates for long-past world events. Helium, the fireproof gas that lifts dirigibles, first was discovered on the sun. Such applications prove how well the romantic science of astronomy pays its way.



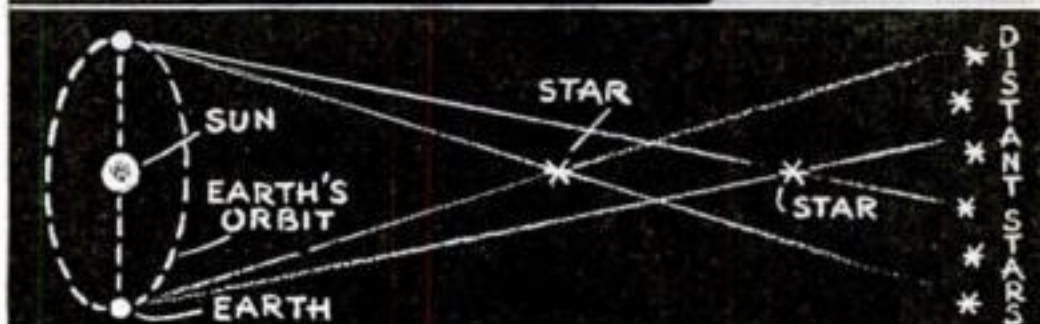
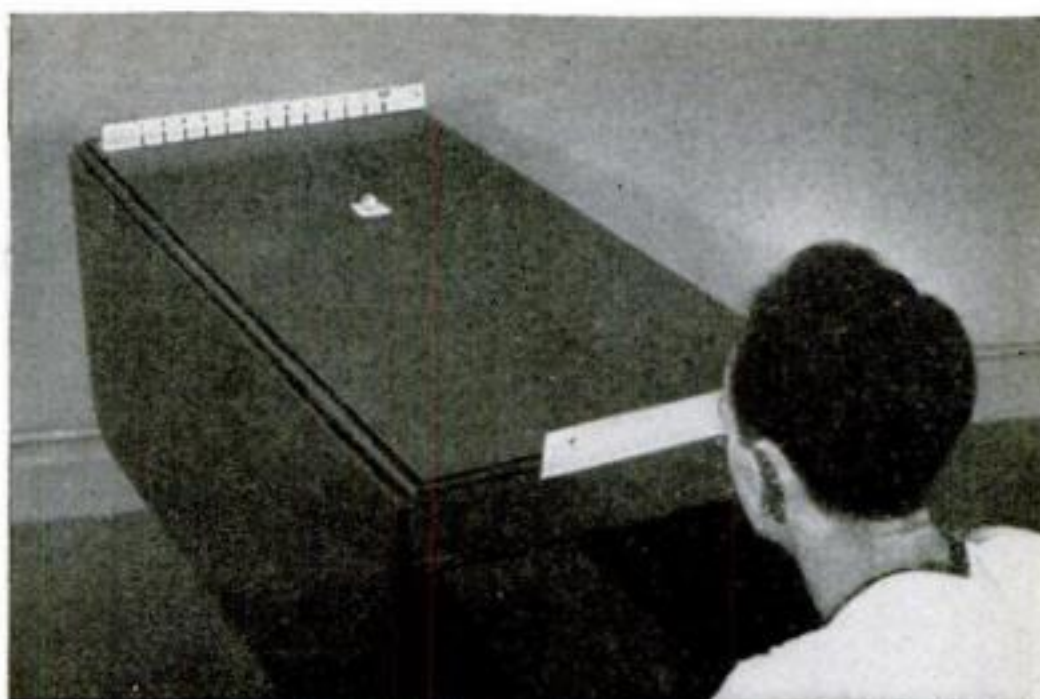
As the stick is turned, the "moon" goes through its phases

PHASES OF THE MOON are easily explained with a simple apparatus. Mount an electric light bulb, representing the sun, on a long stick; and a tennis ball, for the moon, on a shorter one. Then pivot the two sticks, as shown, at a point which corresponds with the viewpoint of an observer on the earth. Sight along the "moon" stick, while you revolve the "sun" stick about it, and you will see the moon go through all its phases. "New moon" occurs when the globe and ball are nearest. As the sticks separate, a crescent moon appears. At right angles, the moon is half full, and it becomes full when the light and ball are farthest apart, as at this time the side of the moon toward the observer is fully illuminated by the sun.

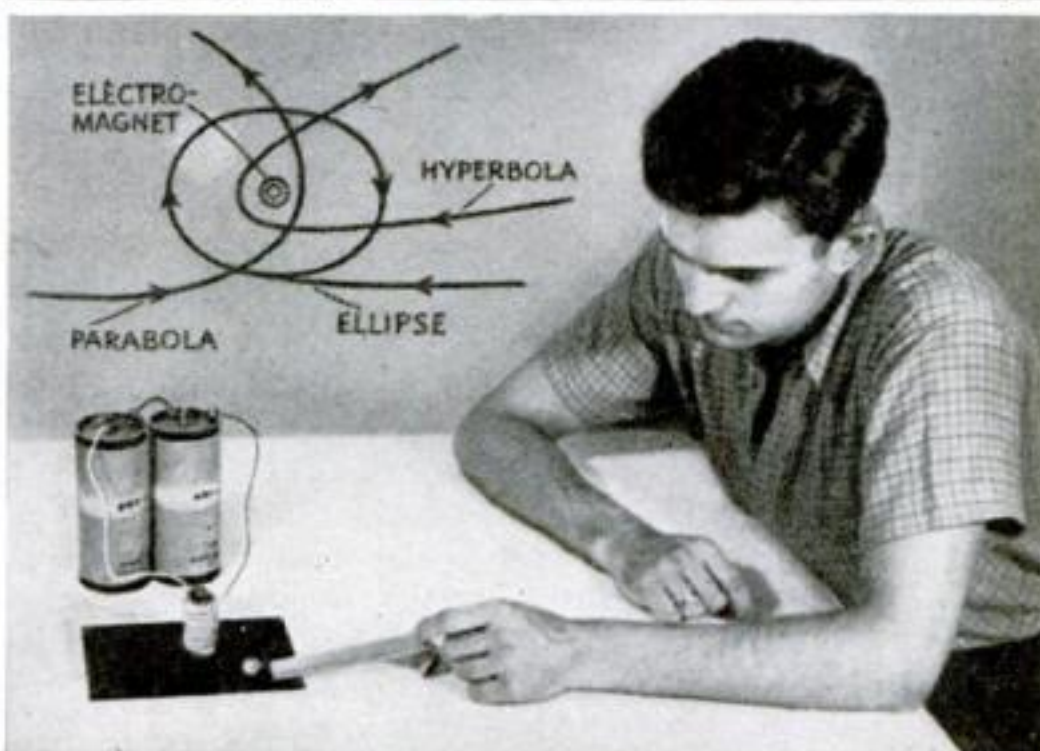


HOW BIG IS THE MOON? Measuring its diameter will prove an easy trick, if you will take the astronomers' word that the distance from earth to moon averages about 239,000 miles. Stick two parallel strips of adhesive tape exactly one and a quarter inches apart on a window pane, so that you can see the full moon between them. Mount a card, punched with a viewing hole, on a stand. Move the stand away from the window until the moon just appears to fill the space between the adhesive-tape strips. Measure the distance of the hole from the strips. This distance is in the same proportion to the moon's distance as the space between the strips is to the moon's diameter. If the distance is $137\frac{1}{2}$ inches, for example, a little figuring will show the diameter of the moon to be 2,170 miles, which is accurate to within one half of one percent.

HOW ASTRONOMERS MEASURE THE DISTANCE TO A STAR. Viewed alternately through a pair of peep holes, a marble—representing the moon, a planet, or a star—appears to shift its position sideways against a more distant measuring scale. This effect is called parallax. A triangle whose base line is the known distance between the sights, and whose angles may be computed by the parallax, shows the distance to the marble at the apex. To find the distance of the nearer stars, astronomers use a base line about 186,000,000 miles long, by taking observations from opposite sides of the earth's orbit. Stars distant enough to show no observable parallax serve as the reference scale. In the experiment, the peep holes represent opposite points on the earth's orbit.



MODEL REPRODUCES COMET'S ORBIT. Roll a steel ball bearing down a cardboard incline upon a sheet of candle-smoked glass with an electromagnet at the center. This may be a carriage bolt wound with fifty or sixty turns of bell wire, which is then connected to several dry cells. Traces left on the smoked glass by the ball show just how the sun's gravitation deflects passing comets into closed or open curves, according to their speed. A comet whose orbit is an open curve never comes back to the solar system.



ECLIPSES OF THE SUN. How can the relatively small moon totally eclipse the much larger sun? The answer is that the moon is just enough nearer the earth to do it, as can be illustrated with a desk lamp for the sun, a tennis ball for the moon, and a sheet of cardboard for the earth's surface. The shadow on the cardboard will have a dark central spot, called the umbra. Pierce the sheet here, and you will see none of the light bulb. Around the umbra you will observe a lighter ring, called the penumbra, on which only a part of the bulb's direct light falls. A solar eclipse will be total or partial, respectively, depending on whether your observation post on the earth is in the umbra or penumbra.



Low-Cost Home Recorder

By
**ARTHUR C.
MILLER**



Making a record with the home recorder. It is just as easy to record radio programs, amplify weak stations, or play regular phonograph records by the simple flick of one of its switches

EXTREMELY versatile, this home recorder will enable anyone to record radio programs, to record home programs, to boost the volume on weak stations, and to play regular phonograph records.

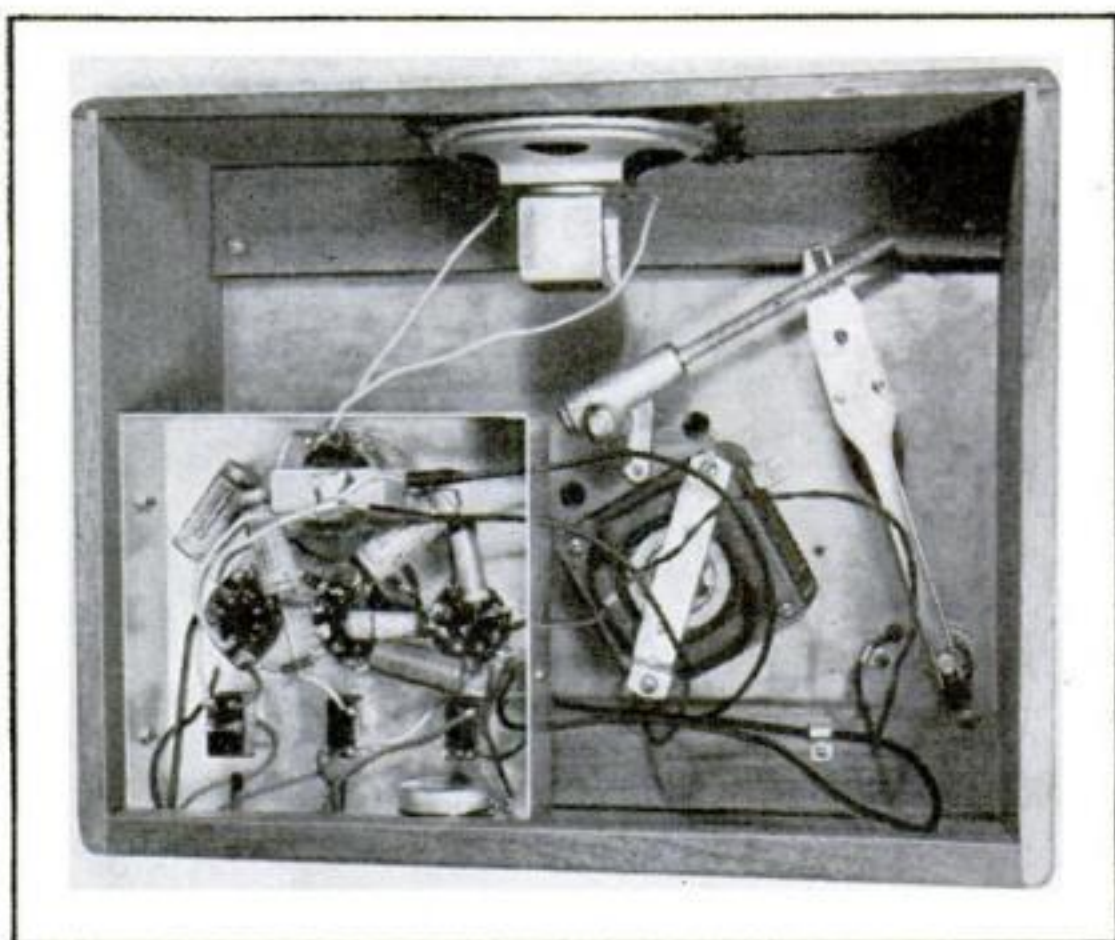
The recording unit on top of the cabinet is very reasonably priced. It consists of a record-cutting mechanism with a concealed feed screw situated underneath the base plate, a high-impedance crystal play-back pick-up, a powerful induction-type self-starting motor, a weighted ten-inch turntable, a cutter-arm rest, a pick-up rest, and a base plate. The unit will cut records up to 10" in diameter and will play records up to 12" in diameter.

A compact three-tube amplifier is used with the home recording unit, and is installed just inside the back of the cabinet on a steel, cadmium-plated chassis measuring 2" by 7" by 7". Output from the amplifier is fed into a good-quality 5" permanent-magnet speaker mounted in the front of the cabinet. The rear of the cabinet is left open to ventilate the tubes and motor.

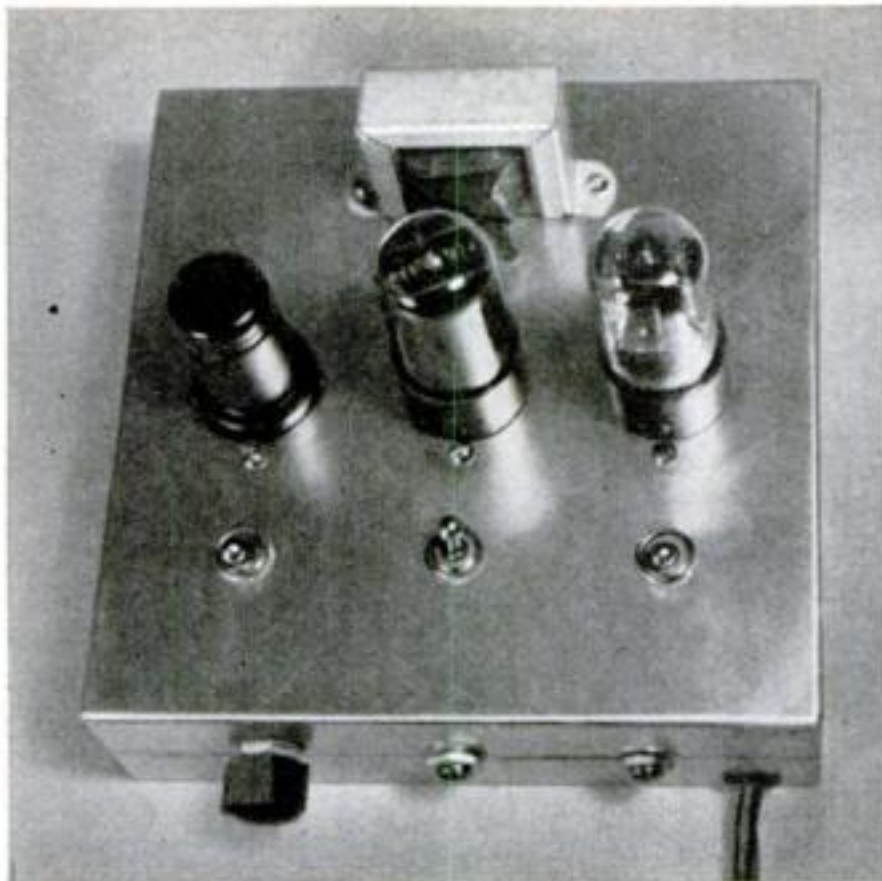
The amplifier proper consists of a high- μ triode, resistance-coupled to a beam power pentode. These two tubes provide all the power needed for either recording or playing records.

A 250,000-ohm variable resistor controls the volume for pick-up or microphone. The voice current for recording is tapped off the plate circuit of the audio output tube through a .1-mfd. tubular paper condenser.

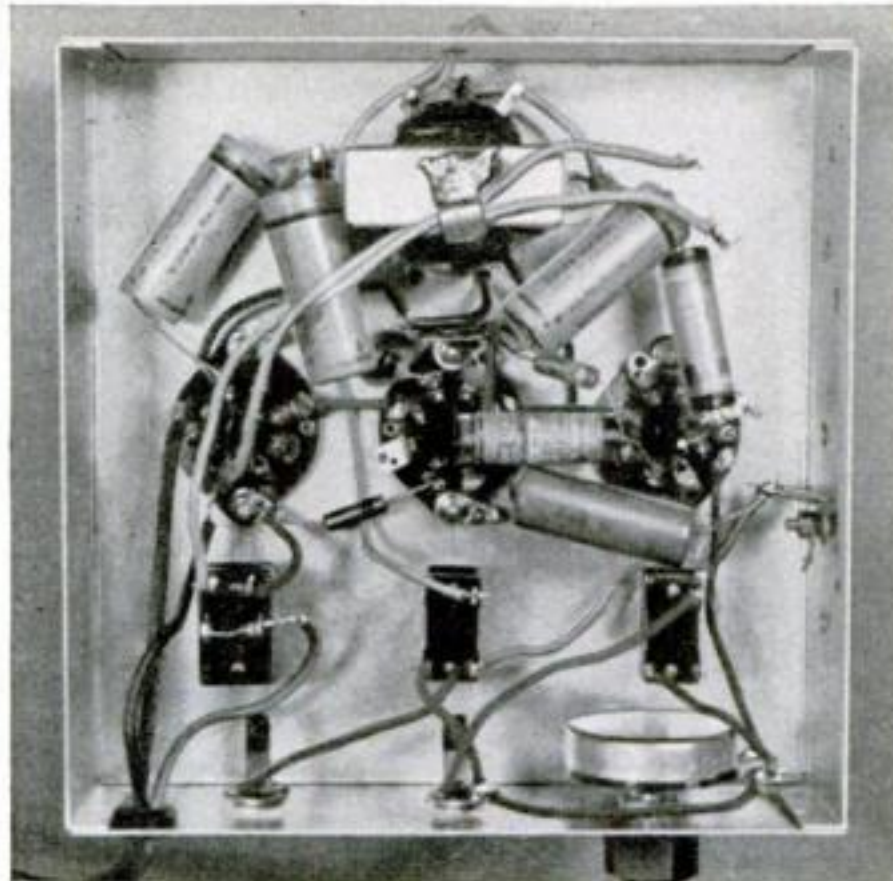
Three toggle switches mounted on top of the chassis regulate the various operations of the instrument. Although an A.C.-D.C. amplifier is used, the motor will operate only on alternating current, so that the unit must not be used on direct current. For



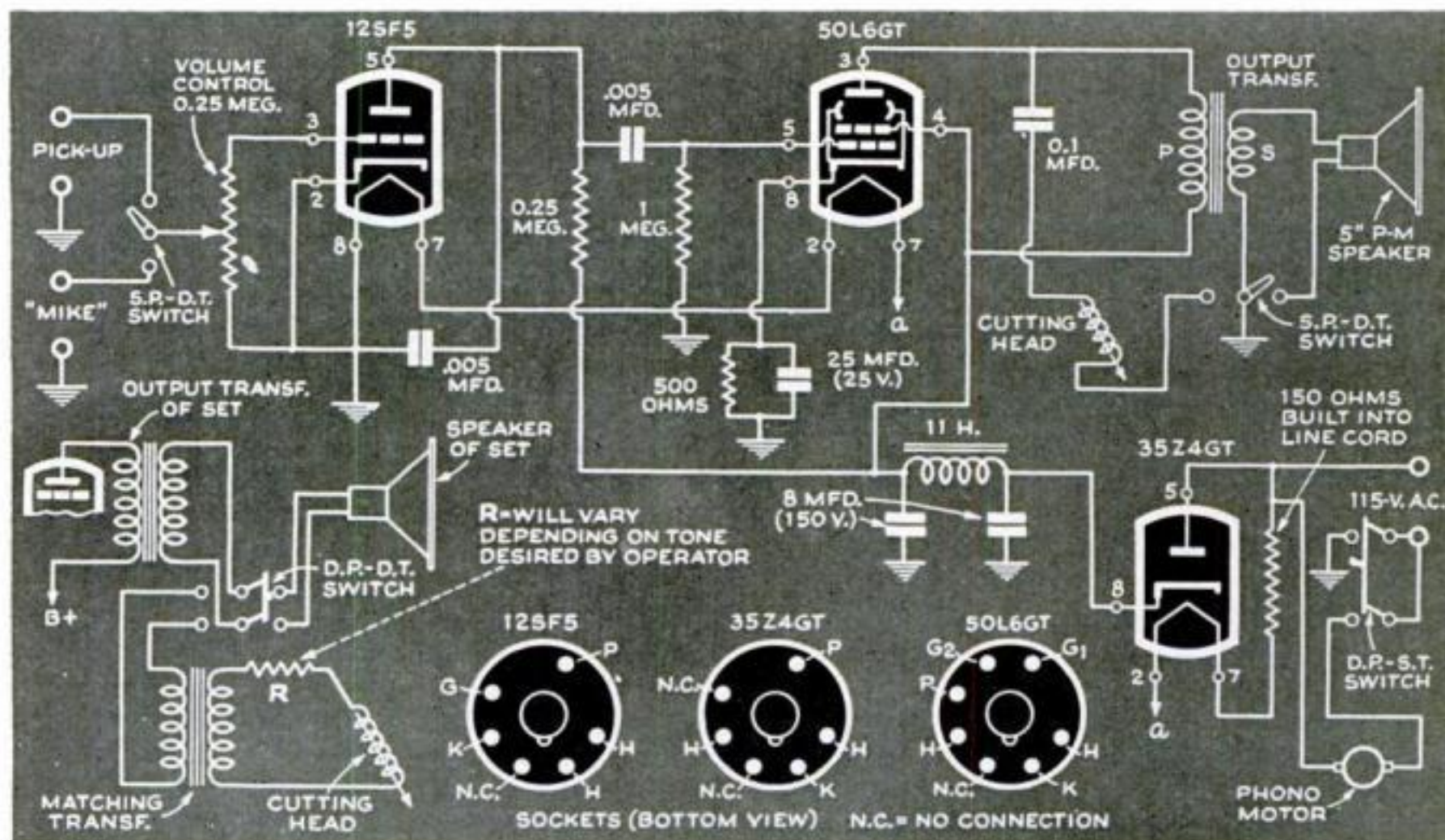
Bottom view of the finished unit, showing arrangement of parts



The three tubes, transformer, and control switches as they are mounted conveniently on the top of the chassis before mounting in a corner of the cabinet



All wire leads are kept as short as possible underneath the chassis. Be sure all connections are tight and arrange the parts approximately as shown here



This circuit diagram will give you all the needed information for hooking up the home recording unit

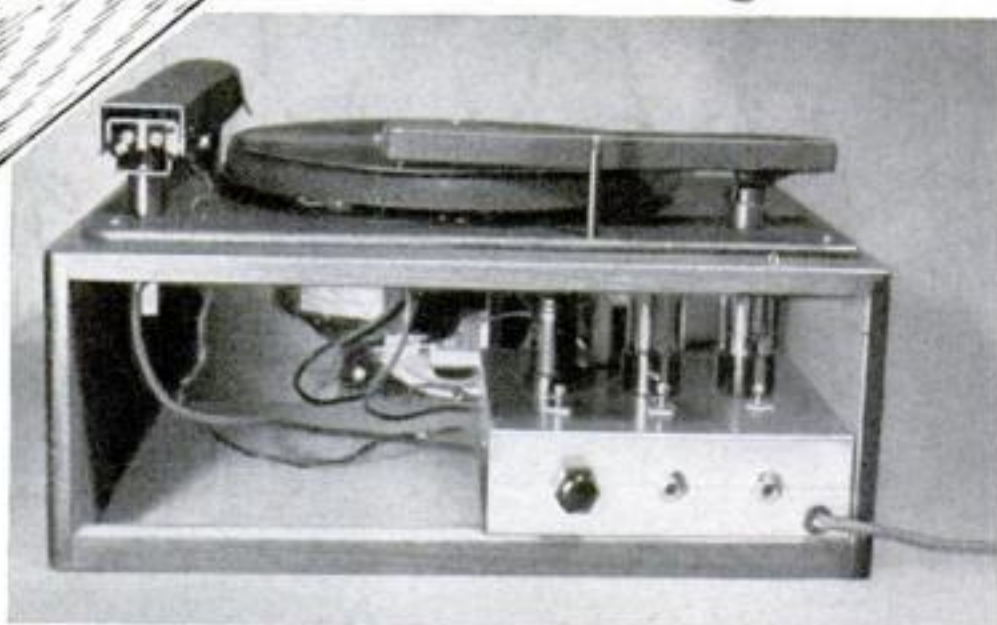
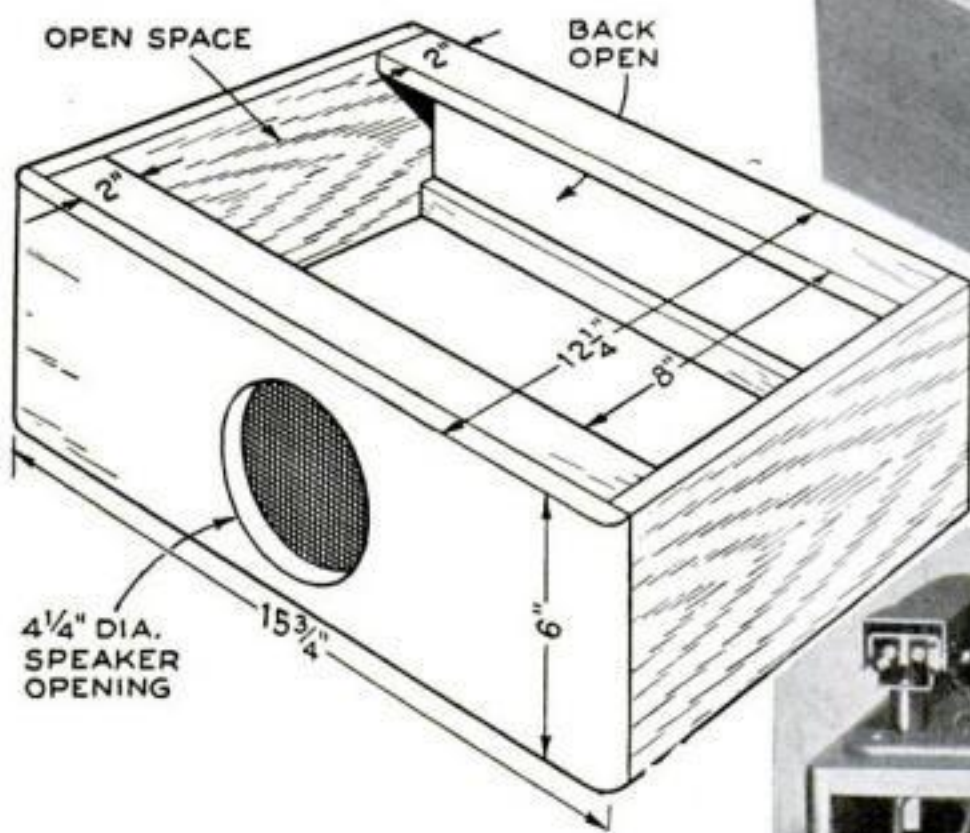
LIST OF PARTS

Home recorder unit.
Cadmium-plated steel chassis.
Triode amplifier tube 12SF5.
Beam power tube 50L6GT.
Half-wave rectifier tube 35Z4GT.
Octal wafer sockets (3).
Volume control, 250,000 ohm.
D.P.S.T. toggle switch.
S.P.D.T. toggle switches (2).
Filter choke, 11 henrys.
Line cord with 150-ohm resistor.
Single-circuit jacks (2).

Permanent-magnet speaker (5").
Universal output transformer.
Electrolytic condensers (2), 8 mfd., 150 v.
Electrolytic condenser, 25 mfd., 25 v.
Tubular paper condensers (2) .005 mfd., 600 v.
Tubular paper condenser, .1 mfd., 400 v.
Carbon resistors: 500 ohm, 1 watt; 250,000 ohm, $\frac{1}{2}$ watt; 1 meg., $\frac{1}{2}$ watt.
Crystal microphone.
Miscellaneous: Cutting and play-back needles, wire, solder, etc.
Blank records.

CABINET-CONSTRUCTION DETAILS

Note that the back of the cabinet is left open to supply ventilation for the tubes and the phonograph-turntable motor. The recorder unit comes with its own base plate ready to be set on the top of the cabinet



use in recording radio programs, the microphone is switched on and placed before the speaker of the radio receiver. In this manner, a permanent recording, right in one's own home, of a favorite dance tune or a historic speech can be made for preservation.

If better quality is desired in recording off the air one should connect the cutting heard directly to the output of the radio receiver through a special matching transformer.

For best results the radio must not be

played too loud, as distortion will occur on the record. The correct volume can best be found by trial and error. When this has been obtained it is a good idea to "monitor" future recordings in order to keep the volume constant. To monitor a recording, headphones are plugged in across the cutting-head circuit so that the quality and volume may be checked.

In recording a voice or home programs directly the microphone should be placed close to the source of the sound. It is advisable first to make a test through the speaker. When the results are satisfactory, switch in the cutting head and record on the blank disk.

A good crystal microphone may be obtained for about six dollars, complete with a desk stand, a 7' cable, and a spring protector for the cable at the mike.

The unit may also be used, as already stated, to boost the volume on weak stations by placing the microphone as close to the receiver's speaker as possible and using the amplifier in the home recorder to increase the volume further.



How the mike is used for recording or boosting programs

PART V . . . A THREE-TUBE TRF RECEIVER



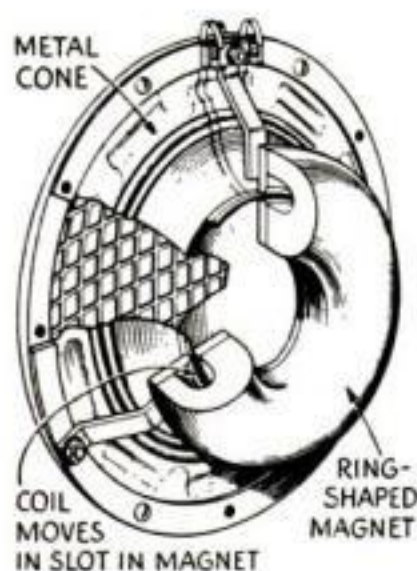
Diagram illustrating the circuit components and connections for the radio receiver, including the 25B8GT and 70L7GT vacuum tubes, various capacitors (e.g., 0.0002 MFD., 0.00014 MFD., 0.0005 MFD., 0.1 MFD., 0.2 MEG., 1 MEG., 16 MFD.), resistors (e.g., 25,000 OHMS, 20 H., 135 OHMS, 500 OHMS), and the power source (115 V. A.C. D.C.).

A black and white photograph showing a hand adjusting a large, circular dial on a control panel. The dial has a scale with numbers from 1 to 10. To the left of the dial is a small, dark, cylindrical knob. To the right, a hand is shown turning a small, dark, cylindrical knob. The control panel is mounted on a light-colored wall.



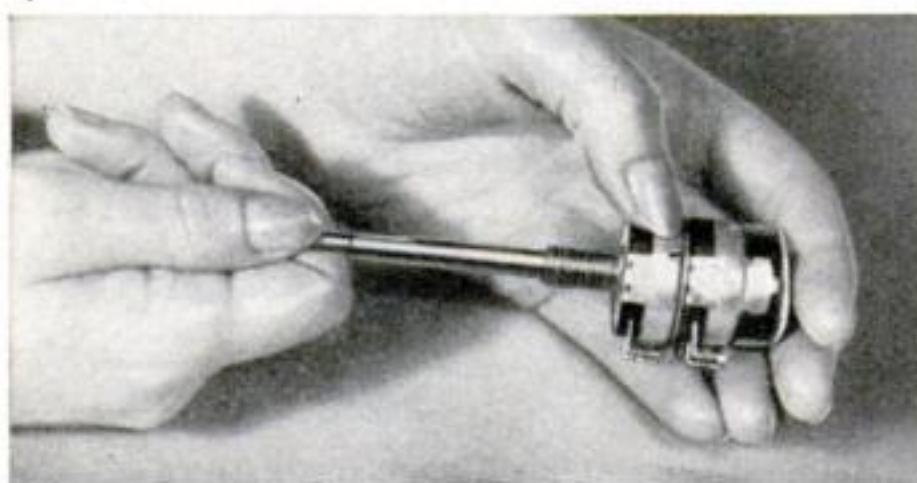
A metal cone and a novel magnet mark the speaker

New Speaker Balances High and Low Tones



UNIFORM sound reproduction is closely maintained from exceedingly low to very high notes with a new loudspeaker that includes a number of design innovations. The cone of the speaker, formed from metal, has a voice coil four inches in diameter that moves in a circular

slot in a permanent magnet shaped like a kitchen baking ring. The diaphragm moves as a complete unit for the lower sound frequencies, but not all parts of it move in unison when higher notes appear in the music to be reproduced.



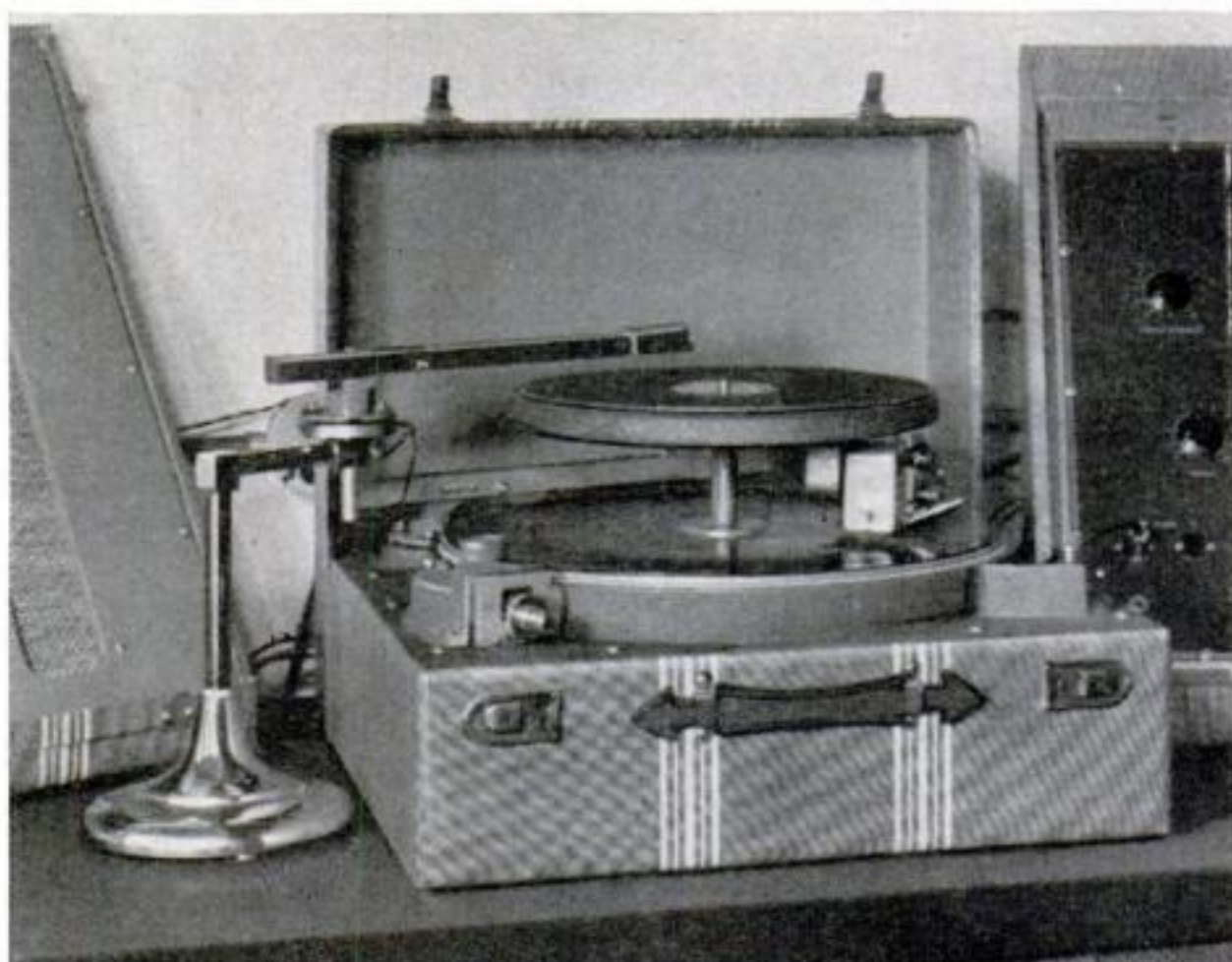
Switch, volume, and tone control, all in one assembly

Three-in-One Control

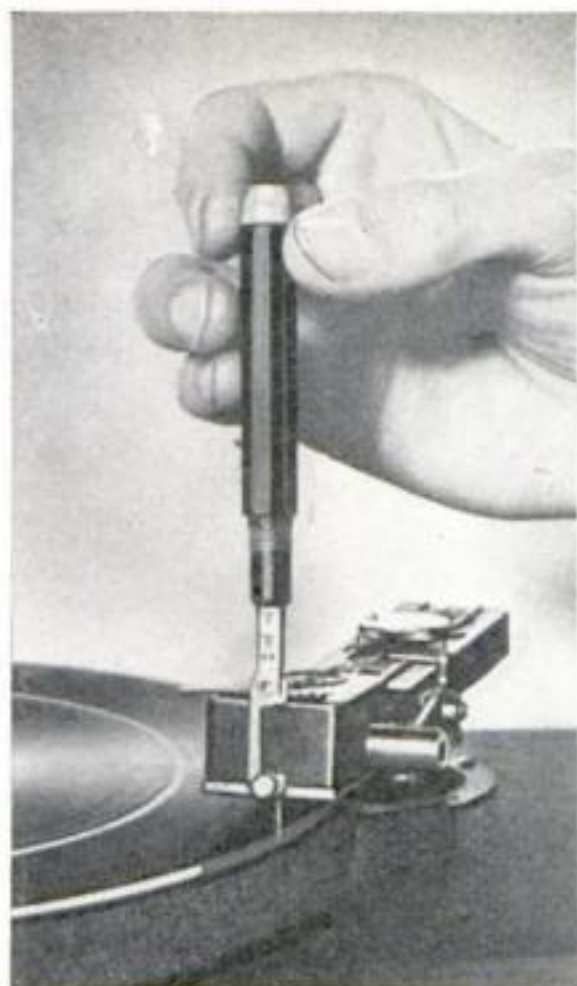
BUILDERS of compact receivers will welcome a new dual control unit in which two concentric shafts turned by a pair of knobs on the same axis regulate three radio-control parts. One of the knobs turns a combination on-off switch and tone control, while the other operates the volume control. The unit, shown in the illustration at the left, occupies little space, and its two knobs appear as one.

Record Copier for Your Own Disks

JUST as a number of photographic prints can be made from a single negative, so many copies of a home recording can be made with the equipment shown at the right. It consists of a pedestal with a hinged arm carrying a cutting head, and an auxiliary turntable which mounts on top of the regular turntable. Any recording played on the regular turntable can be picked up by the auxiliary cutting arm which "copies" it on a new blank.



Copying an old recording on a new recording blank with the apparatus



New Pocket Scales Weigh Tone Arms

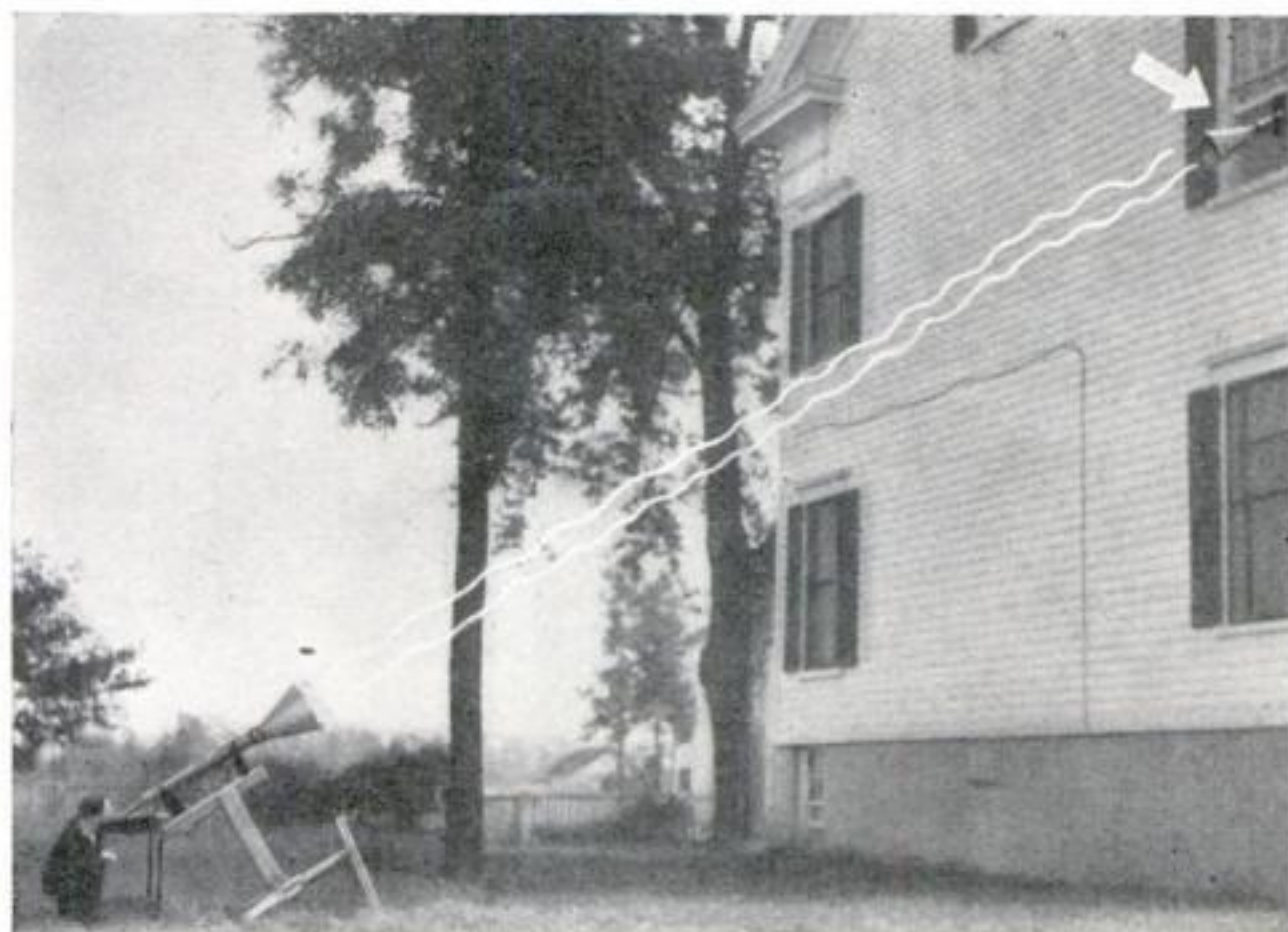
DESIGNED for radio service men and home experimenters, vest-pocket scales registering in ounces are handy for weighing tone arms to show how much pressure is being brought to bear on phonograph needles. The hooked end of the scales is placed under the needle-holding thumbscrew to lift and weigh the arm.

Auxiliary Loop for Portable Sets

AN AUXILIARY loop antenna to improve portable radios in areas where reception is poor has just been marketed. As the antenna plugs into a radio, it automatically disconnects the self-contained loop. Vacuum cups attached to the unit will hold it to a window pane or other flat surface.



How vacuum cups hold the booster antenna against a window pane

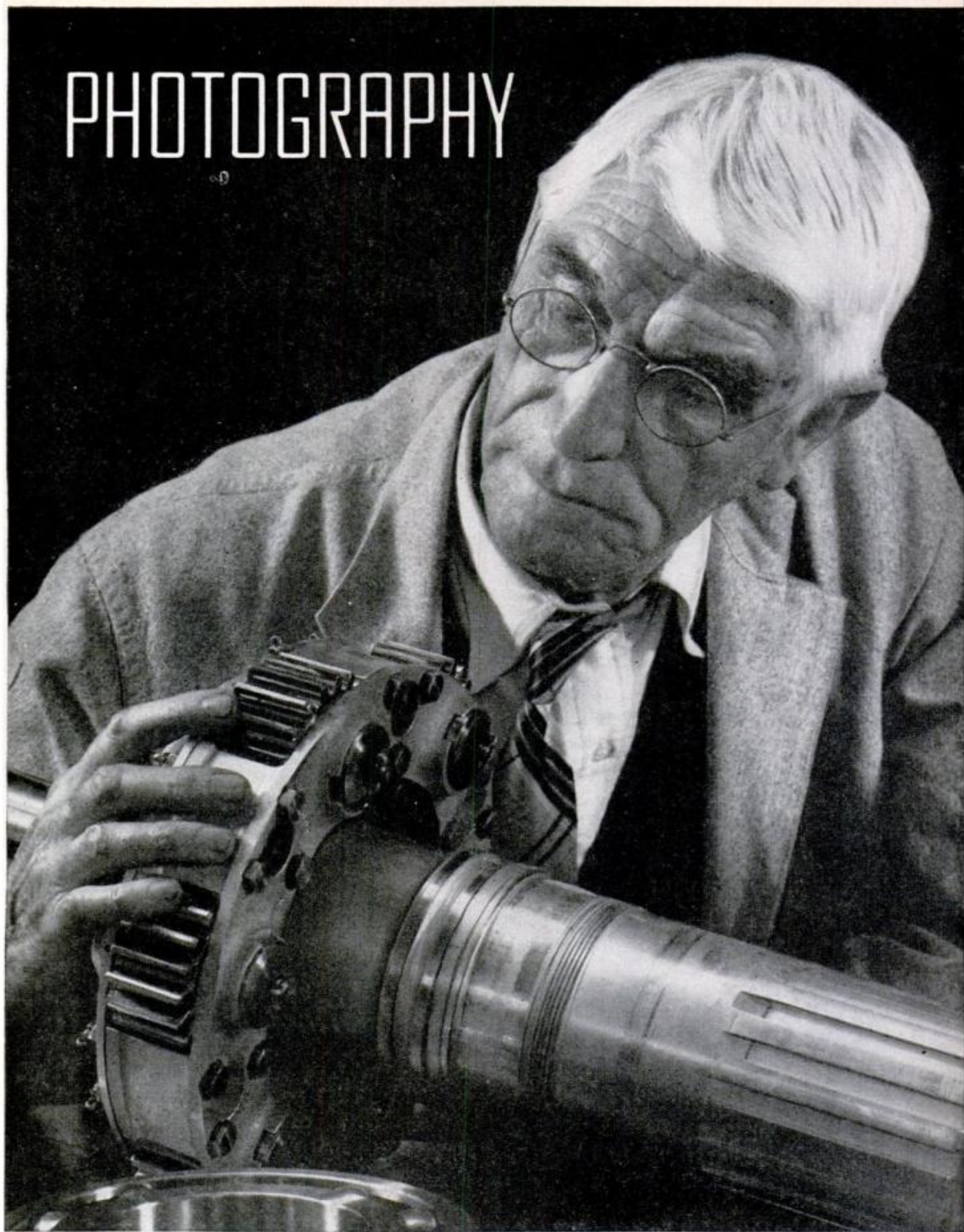


An experimental set-up demonstrating the hornlike antennas for radio signals

Antenna Horns Give Direction to Radio Waves

THAT metal horns can concentrate certain types of radio waves along a path just as they concentrate and direct sound waves has been demonstrated by A. P. King, of the Bell Telephone Laboratories. As shown in the photograph, the horn antenna of a transmitter is aimed at a similar antenna on a receiving radio set.

PHOTOGRAPHY



COURTESY OF COLLIER'S

Dmitri Kessel, who took this picture, looks upon industry with the eyes of an artist. Here he has symbolized all the skill of American mechanics. The photo shows a propeller shaft for an airplane engine at the Pratt & Whitney plant, Hartford, Conn. Deerdorf 4" by 5" camera with 14" Zeiss Protar convertible lens; stop, f/45; time, 1/100 second; lighting, three flash bulbs; film, panchromatic; developer for film, D-76; developer for paper, D-72

Dramatizing Industrial Photography

By JOHN H. WALKER

FIVE years ago the name of Dmitri Kessel was absolutely unknown in photography, for the very excellent reason that he wasn't a photographer at all.

He had been a soldier, clerk in an import house, correspondent for a couple of Russian publications. None of these jobs seemed to turn out conspicuously well. It was a time for taking stock, and in adding up his talents Kessel reached the somewhat obscure conclusion that he might as well get aboard the boom in photography.

Kessel was 33 years old. His total experience with a camera consisted of a little amateur dabbling, plus a short period of

taking military record photographs—a kind of primitive signal corps work for the always ill-equipped Russian forces.

It took courage of a fairly high order for a man in his position to set out from scratch to learn the complex technology of a new profession, in a field which has never been conspicuously undercrowded. Yet, having decided to gamble with his time and savings, Kessel

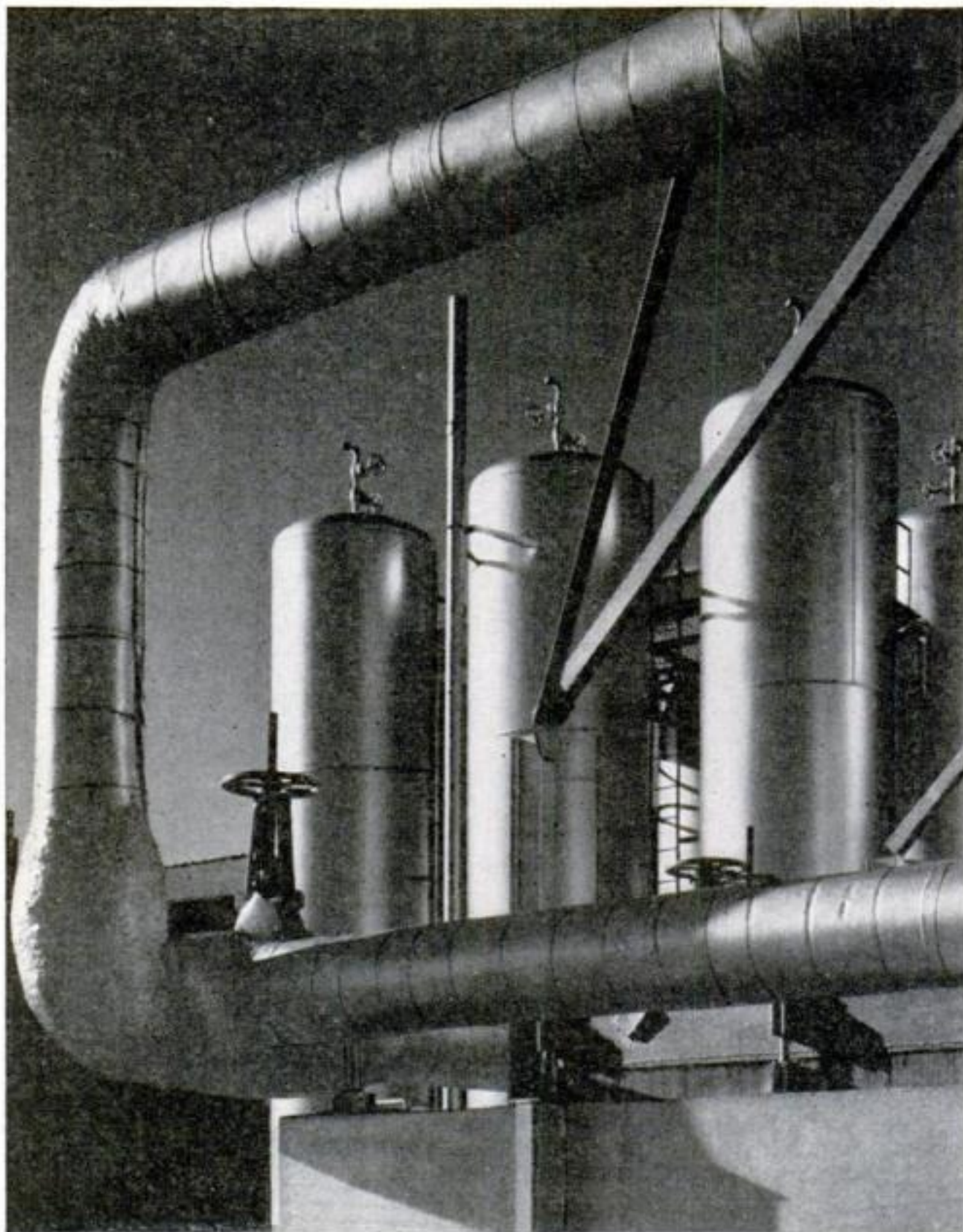
made a good job of it. He went looking for the most thorough and exacting photography course to be found, and finally enrolled at the Rabinovitch School in New York, where the course costs a cool \$500.

And seldom has a man's bet on himself

Ship's turbine under construction at Newport News Shipbuilding & Dry Dock Co., Newport News, Va. Linhof 3 1/4" by 4 1/4" camera, 7 1/4" Protar lens; stop, f/22; time, 1/100 second; four flash bulbs; pan film

COURTESY OF LIFE MAGAZINE





Composition and light—these tell the story for Mr. Kessel, as in this view of tanks and pipes. It was taken with the Linhof camera and a 5" Protar convertible lens. Stop, $f/22$; time, $1/50$ second; K-2 filter and pan film



Studio pictures are a rarity for Mr. Kessel; he does practically all his work "on location"

saying that he decides what is going to be left out of the picture, and what is going to show to best advantage.

His general rule for making industrial photographs is to dramatize the subjects. He feels it is virtually impossible to overemphasize the power and beauty of the machine and its role in modern civilization.

One of the odd facts about Kessel is that he almost didn't become an industrial photographer. When he built this new career for himself, he was understandably anxious to pick out a specialty which would pay reason-

ably well and yet provide some room for a newcomer. The first guess, based on friends' advice and a cold-blooded survey of the field, was fashion photography. He tried it, and had rather good opportunities for work, but felt compelled to give it up. "It was too soft." His second guess was industrial photography, which proved to be more like it.

Among his first jobs were assignments for major steel firms, and one of his great triumphs early in the business was a set of superlatively good photographs of the pouring of molten steel. From a photographic point of view, this subject is an extraordinarily tough one. The mill itself is dark; the glowing steel gives off tremendous light.

Most photographers had tackled the problem by massing banks of flood lamps to pour out masses of light and get a reasonable balance between the hot metal and the

He does not go in for props or special backgrounds. His pictures show no more than what is there; the only controlling factors he employs are those of composition and light—which is a technical way of

turned out better. Kessel today enjoys an international reputation as an outstanding industrial photographer. He functions as a super-portrait painter, recording the ever-changing face of American industry. His work divides roughly into two classes—pictures made for his industrial accounts (the corporations themselves) and special assignments for magazines, notably "Life" and "Fortune."

He maintains headquarters in New York City, but does virtually no studio work. He ranges all over the United States on assignments, traveling constantly and taking his pictures "on location."

machinery used in the process. This turned out some striking photographs, but nothing which hard-bitten steel men thought looked like the actual pouring of a charge of steel.

Kessel decided that most of his predecessors had gone at the task from a wrong angle. The problem, as he saw it, was one of time rather than light intensity.

"For one thing," he explains, "I noticed that there was a really surprising amount of vibration on the floor. I tried shooting at one-hundredth of a second, with thirty flash bulbs strung around the place, all fired together from a battery box."

It worked. The tiny flying sparks of steel in the pouring process showed up as sparks, not long streaks of white along the picture. Old steel men who had watched the process daily for years cussed with delight and said, "That LOOKS right!" A good industrial photographer wants no higher praise.

Kessel has solved many another tough technical problem since. Probably the nastiest job of all was shooting a paper mill, and working in the digester room, where the normal temperature is 130 degrees and hardened mill hands work in stretches of 15 minutes on the job. His camera and lens began to "sweat" as soon as he went in, and it took 20 minutes to acclimatize the lens. By then the leather bellows was limp and sagging, while the film and Kessel were near the melting point.

Another problem which comes up fairly often is that of photographing some small instrument, perhaps no larger than a pinhead, which must be "blown up" to 11" by 14" for publication or exhibition. Then he uses an extreme short-focus, wide-angle lens, and gets the front element of the lens up to within an inch or

two of the subject. He focuses with a movable backboard, and thus gets five or six times magnification on the original negative.

Most of Kessel's work is done with a Linhof camera, 3¼" by 4¼" size, completely rebuilt for his purposes. He has it fitted with a front and back which lift, turn, or swing in any direction, a range finder, parallax compensator, and several synchronizers, "none of which ever work just right." He likes to use a Rolleiflex in the popular 2¼" square size for general outdoor work, and employs 35-mm. miniature cameras occasionally for color pictures.

One of his most interesting assignments, early in his magazine work, was that of recording Czech industry for "Life" and "Fortune." He was the first to photograph the Bata works, at Zlin, which had become headquarters for *(Continued on page 230)*

Laboratory technician examining serums. Linhof camera with 80-mm. Protar lens; stop, f/32; time, 1/100 second; light, three synchronized flash bulbs

COURTESY OF LEDERLE LABORATORIES, INC.



Two-Section Developer Can Serves as Water Filter



Above, the complete filter attached to the darkroom faucet and, at right, the parts before they are put together. This arrangement gives three separate filter units



AN EMPTY $\frac{1}{2}$ -gal. developer can of the type having two compartments can be converted into a good filter for the water used in washing films and prints and in mixing chemical solutions. Make a hole in the lid and in the bottom, and solder into each a $1\frac{1}{4}$ " length of brass or copper tubing about $\frac{1}{2}$ " in diameter. Then punch as many small holes as possible in the bottom of the small inner container.

Cut two or three disks of cloth the size of the container and drop them inside, over the holes. Place two or three layers of cloth loosely over the open top of the container, press the lid firmly in place, and trim away the surplus. Then lay two or three more layers of cloth over the top of the can proper and press the top section in place. The number of layers of cloth will depend upon their thickness; the finer the cloth, the more efficient the filter will be. Connect the filter up with rubber tubing and turn on the water slowly at first until the cloth becomes wet. Change the cloth whenever it be-

comes dirty. You'll be surprised at the amount of dirt taken from the tap water in a comparatively short space of time. It is a good idea to cut a number of extra cloth filters at the time that you assemble the filtering device.—
C. H. TAYLOR.

Use This Title to Start Your Winter Movie Film



WINTER has arrived, and to the amateur movie enthusiast the season offers hundreds of opportunities for photographing beautiful snow and ice scenes; skiing, skating, and sledging parties; and winter outings of friends or family. When the photographer prepares to edit his film, he needs an appropriate opening title for the scenes to follow, and the one at the left fills the bill nicely. It may be used in any of the small commercial titling outfits. Because this magazine is printed on glossy paper, beware of reflections from the lighting unit when shooting the title.



Left, Mr. Squirrel comes for breakfast and has his picture taken. An enlargement of the animal is reproduced below

Left, hang a few evergreen boughs around a feeding station to make the wild life feel more at home. The foliage also gives a realistic touch to the setting

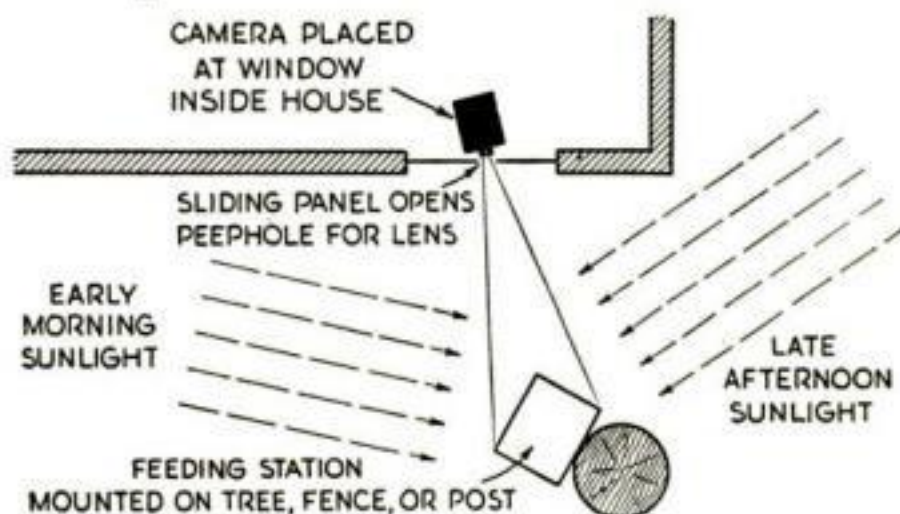


Feeding Station Lures Wild Life to Your Camera for Close-Ups

LATE winter, when snow blankets the earth and wild life has difficulty foraging for food, is the best time of year to take good pictures of birds, squirrels, and other small animals. This can be done with the aid of the feeding-station set-up illustrated. The absence, during this season, of shady overhead foliage and the presence of the light-reflecting snow make lighting conditions ideal.

Mount the feeding station on a tree, fence, or post within camera-shooting distance of a conveniently located window. The focal length and angle coverage of your lens will, of course, determine this distance. A low angle of sunlight produces the best modeling illumination, therefore try to spot the station so that it gets the benefit of early morning and late afternoon sunlight. A smoothly sliding window panel, which can be drawn back silently to open a peephole at which the camera is placed, is an aid in getting good, natural-looking photographs of the wild life. A panel like the one illustrated can be made of plywood or pressed board and may temporarily be substituted for the upper or lower sash of a common double-hung window, or installed in place of the hinged frame of a French-type window, or may be substituted for a single small pane.

When the set-up is completed, with the camera loaded and the shutter set for tripping, cover the camera, excepting the lens and cable release, with a dust cloth. Stock

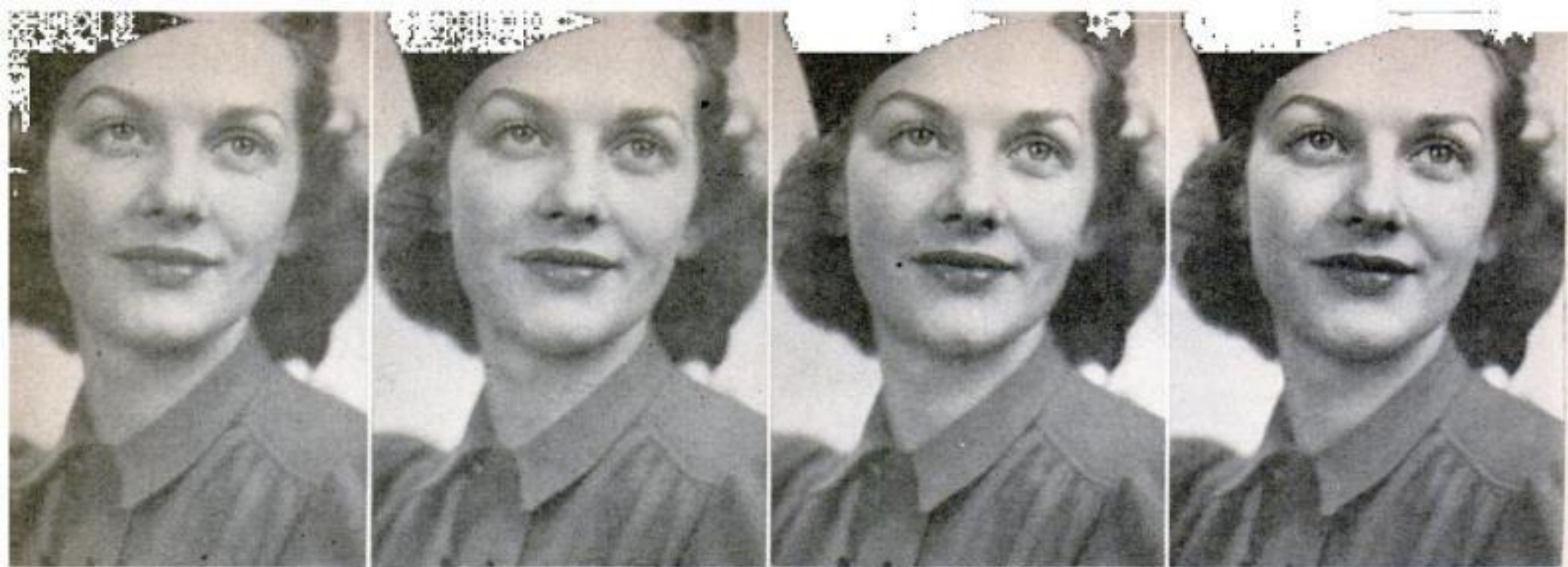


When the opportune moment arrives, draw back the panel quietly, and then trip the camera shutter

the feeding station with food and then wait for your subjects to appear.

Timid birds and animals can be lured up onto the station by first enticing them with food scraps thrown on the ground below it. Hanging a few evergreen boughs around the station not only makes the wild life feel more at home, but also adds a realistic touch of background foliage to the pictures. If the station itself is to be painted, green seems to have more attraction than colors on the red side.

The use of ultraspeed panchromatic film, permitting short exposures in the early morning and late afternoon, is recommended. Do not overexpose, however, if the delicate textures of feathers and furs are to be brought out to best advantage in your enlargements.—JOHN MODROCH.



All these prints were made from the same negative
Harrison & Harrison contrast-control filter for each



By **WALTER E. BURTON**

POINTS TO REMEMBER

- 1** Use a yellow filter for softness, a blue filter for contrast. Mix the two for in-between results.
- 2** Handle the paper only in the illumination from a light red safelight.
- 3** Develop the print until it looks a bit too dark in the red light.
- 4** Leave prints in hypo at least a minute before removing them for examination.
- 5** Toning processes may be used successfully, but the hypo-alum for sepia will not give quite so good a tone.
- 6** Contrast-control filters are balanced for a Mazda lamp. Other lamps may change the ratio slightly between filters.

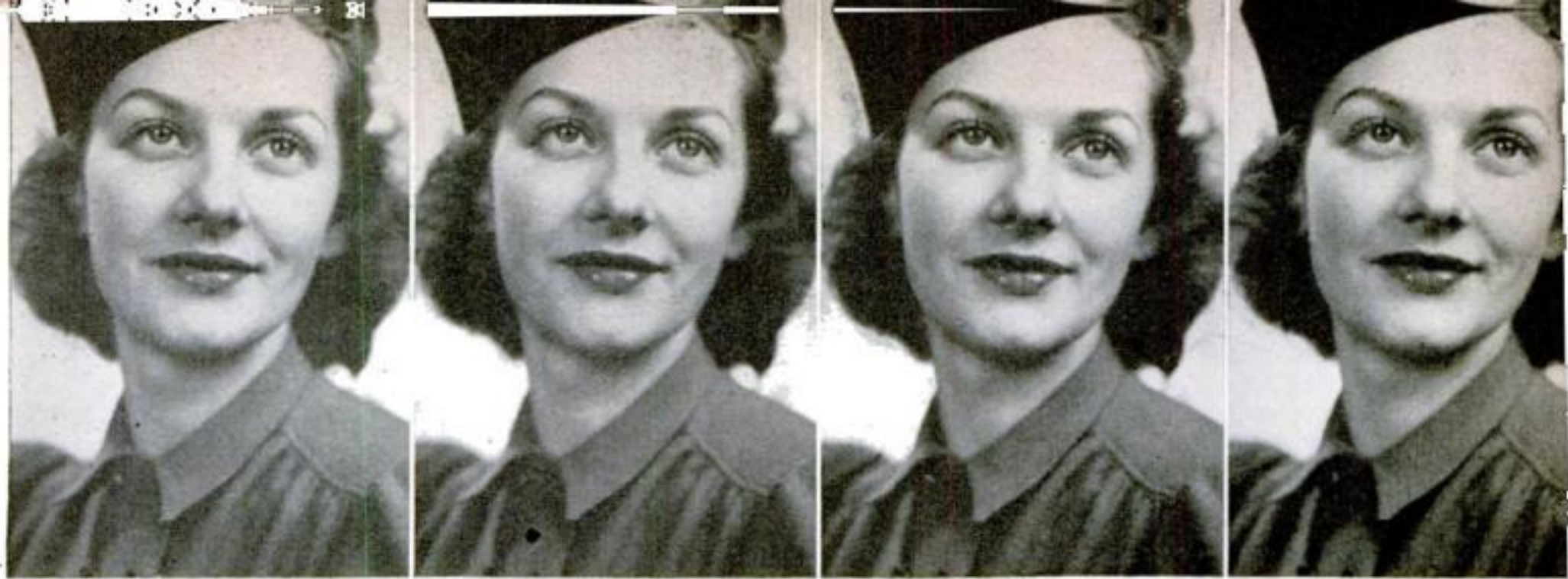
PHOTOGRAPHY has borrowed an idea from radio. The camera user now can buy a package of special enlarging paper and "tune" each of the sheets to match any printable negative he may have. By a very simple method he is enabled, as it were, to select a visible radiation of a certain wave length and use it to impress an image into the sensitive emulsion. That is why the paper has been named "Varigam," meaning variable gamma.

This is indeed new magic for the photographer. Imagine keeping only *one* grade of paper in your darkroom, yet being able to match perfectly the contrast of any negative fit to print!

But it goes further than that. You can do things in the darkroom that were impossible before, such as printing part of a picture with a lot of contrast and part with little, or matching a contrasty cloud negative and a flat landscape negative. It is ideal for photo montages and for paper-negative work.

Heretofore, ordinary photographic paper has been color-blind—sensitive only to blue light. The new paper sees both blue and green light, but not red; and a red safelight has to be used with it.

The blue-sensitive part of the paper is made so the image it produces is very contrasty. The green-sensitive part gives an image that is very soft. Color filters are therefore used to regulate the contrast of the new paper. For projection printing, a filter is used in front of the enlarger lens. (In case contact print-



with the same exposure time on Varigam enlarging paper. The variation was controlled by using a different exposure, but similar results may be obtained with only the blue and yellow filters supplied with each package

ing is to be done, a sheet of filter material is placed between the printing light and negative.)

A blue filter gives contrast, a yellow one softness. Yellow is used instead of green because focusing by green light alone would be inefficient. The yellow filter passes green radiation, plus enough other wave lengths to make seeing easy.

In each package of the new paper are a pair of 2" square filters, one yellow and one blue, and a simple cardboard holder in which to mount them. For some negatives, either filter alone is used; but for the majority, a combination exposure is best. Thus a nearly normal negative might require four seconds exposure through the yellow and six seconds through the blue.

There is, theoretically, no limit to the steps in contrast. Actually, eight or ten degrees of contrast will cover about everything. With Mazda light, the exposure through either filter, or the total through the two in sequence, is the same. The blue filter is preferred for making time-test exposures. For professionals and advanced amateurs and for all critical work, graded sets of five or ten yellow-blue glass or gelatin filters are obtainable.

The new paper, which is available in five different surfaces, makes "dodging" much easier.

If you like to make photographic greeting cards, bookplates, or other prints that involve black-and-white lettering in combination with a portrait, landscape, or tabletop picture, simply print the scene with blue-yellow light to give the proper contrast, and then use blue light alone for the lettering.



The soft print at top required a 10-second exposure through yellow filter; the medium print, 5 seconds through yellow, 5 through blue; the contrasty print, 10 through blue. The two filters come with the paper and are mounted as shown at left

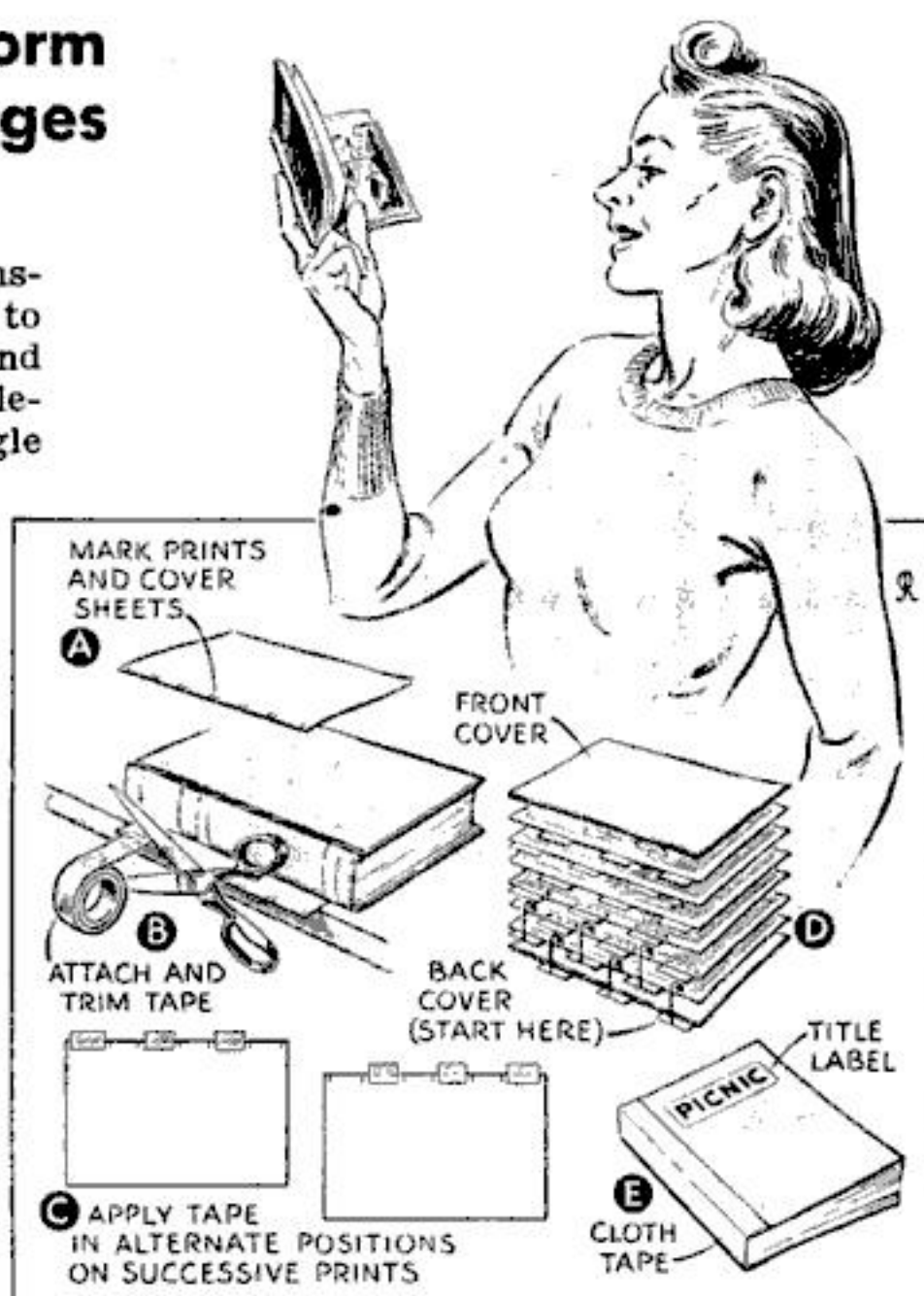
Prints Bound in Book Form with Cellulose-Tape Hinges

A PAIR of shears and a roll of $\frac{1}{2}$ " transparent cellulose tape are all that you need to bind a set of snapshots into a novel and durable "book." Up to thirty-five single-weight prints may be bound into a single "volume."

First arrange the prints and number them to keep them in the desired order and position while working. Prepare cover sheets of suitable material, the same size as the prints. With light pencil marks, space off the back of each print and of the covers, along the edge that is to be bound. Make an even number of spaces the exact width of the tape, with from $\frac{1}{16}$ " to $\frac{1}{8}$ " between spaces as at A. Start taping on the last "page," that is, the back cover sheet.

The end of the tape is stuck in position on the print, then cut off with the shears (B) to extend over the edge about $\frac{3}{16}$ ". On one print the tape is stuck on in the even-numbered spaces, on the next print in the odd-numbered spaces (C), and so on.

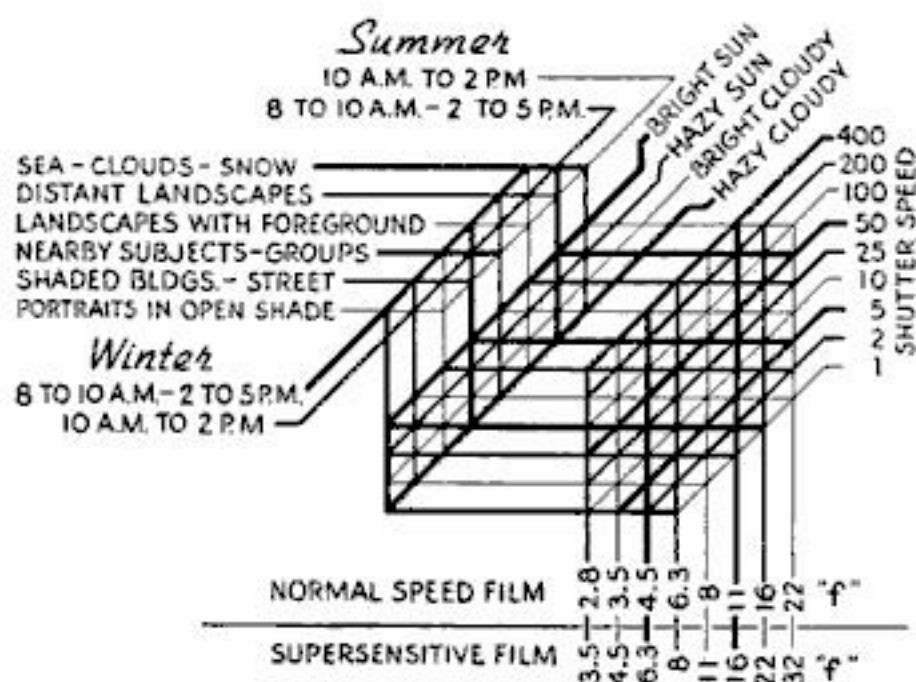
The back cover is now held with the sticky side of the tapes up, and the first print is laid evenly on top of it. The tapes of the back cover are then turned up and over on it. The assembly is then continued as shown in diagram D until the photo book is completed.



Final touches include a "back" of black or brown tape, and a little label (E). Inscriptions to accompany each picture may be written on the back of the preceding picture or typed on a piece of gummed tape and stuck in.—G. H. MOUW.

OUTDOOR EXPOSURE GUIDE

DESIGNED BY RAY KINSLOW



POPULAR SCIENCE MONTHLY SHOP DATA FILE

[PHOTOGRAPHY]

To determine the proper lens stop to use, begin with the subject being photographed and follow that line until you come to the one corresponding to the season and hour. Then go down to the line corresponding to prevailing sky conditions; continue horizontally to the shutter speed desired; down to the type of film being used, and note the correct stop to use. For ease in following the lines, color the medium-weight lines with a red pencil and the light lines with blue.

Photo Exposure Meters

HOW THEY ARE
MADE AND HOW
THEY WORK

•
By Jack Price

Photographic Editor of "Editor and Publisher" and Lecturer on News Photography

THE photo exposure meter is neither a gadget nor the product of an overnight experiment. It is a high-precision instrument representing almost 100 years of scientific research.

Reams of copy have been written about the applications of the photo exposure meter, but little attention has been given to its construction and development. Three discoveries lie at its foundation. In 1839, a French scientist, Edmond Becquerel, discovered that light increased the output of voltaic cells (a wet battery) when it fell upon platinum-coated electrodes. Thirty-four years later Willoughby Smith, a telegrapher then working in the Azores, noticed that the selenium in his line-testing instrument changed its resistance to current when light fell upon this element. In 1887, Heinrich Hertz, a German scientist, found that electrically charged particles, or electrons, were shot off certain substances when exposed to ultra-violet rays.

Down through the years until 1930, we had no accurate light-measuring instrument for commercial use in photography. In that year a light cell was placed on the German market, but because it was none too stable it was not manufactured in this country.

In 1928, Edward F. Weston, president of the firm bearing his name, became interested in developing a meter which could measure the intensity of light. He made a



Exposure meters are incredibly precise instruments, and each new one has to be given the most careful inspection

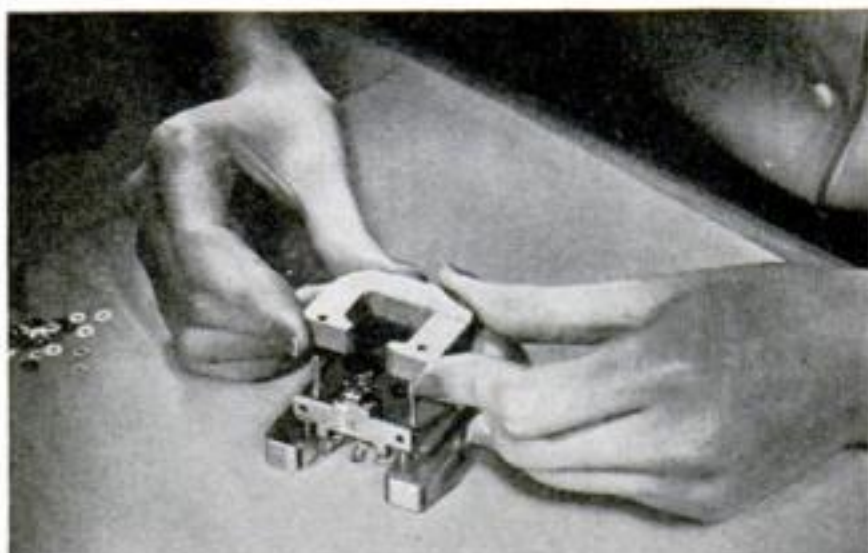
thorough study of all known light-sensitive materials, and with the assistance of his engineering staff developed a selenium cell that could be depended upon to perform with accuracy and stability. By 1930, he and his staff perfected a cell that became the basis for his instrument, then called "Photronic Exposure Meter" but now generally spoken of as a "light meter." In 1931 production for commercial use was begun.

General Electric engineers conducted experiments with selenium cells in 1932 and eventually perfected one that proved accurate and dependable. At first these cells were incorporated in instruments mainly for use in recording general illumination. In 1937 this company produced a photo exposure meter for photographers.

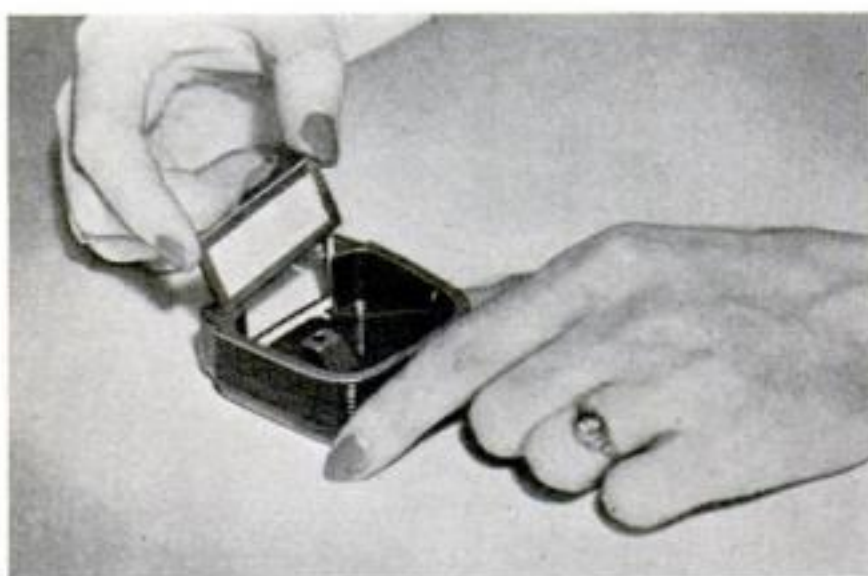
Both Weston and G.E. employ the same principle in construction, and each has incorporated the selenium cell as the essential factor. If selenium alone were used in the cell, it would be ineffective because it is susceptible to weather conditions and strong light, such as sunlight. It was therefore necessary to find a formula which would

increase the efficiency of the basic element.

In each instance the cell is constructed by first depositing the selenium upon a chemically treated piece of iron or steel. Weston uses a disk as a cell base, while the G. E. cell has a rectangular-shaped base. In both makes the selenium is coated with layers of a secret composition of conducting metals. This composition contains certain alloys and precious metals, including gold and



Assembling the simple but important permanent magnet on the moving unit of a Weston meter



The "eye" of the meter. Here the photo electric cell is being placed in a General Electric meter

platinum. The layers of this material are so thin that they are referred to as "molecular." Strangely enough, these coatings are transparent although made of metal.

When these cells are completed, they are tested under the severest conditions. They must react to the highest and lowest levels of light and send out the required quantity of electrons. Both factories prescribe a series of tests of the cells, including the exposing of test cells to strong sunlight and weather conditions over a period of years. When a cell has been passed as perfect, it is sent to the assembly room where it is built into the meter.

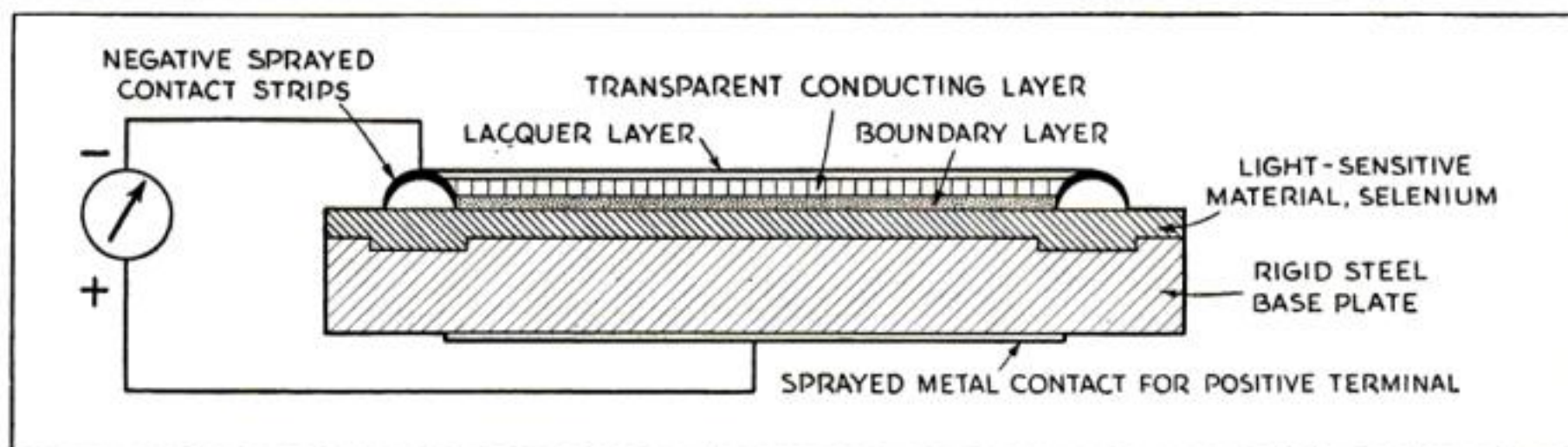
There are no batteries hidden in the meter cases because none is required. The light which falls upon the cell creates a minute amount of electricity. This current is measured in millionths of an ampere. The average recording shows that about four micro-amperes are generated for each foot-candle of light intensity. The current thus generated is passed through a coil set in a magnetic field. This entire circuit of coil and cell must be perfectly balanced for best performance. This movable unit is patterned along the lines of the d'Arsonval galvanometer.

A needle or pointer is fixed to the movable unit. This moves according to the power generated by the selenic cell. The stronger the light, the greater the energy. In order to insure a stable instrument, a strong magnetic field is required, and in the design of the magnet much research was necessary to predetermine the amount of magnetism needed.

All through the stages of manufacture, each piece of mechanism is tested according to the standards of measurement established by the United States Bureau of Standards. The various parts in the meter



So precise is the work required in making exposure meters, that these girls on the General Electric assembly line wear lintless white smocks and work in the filtered air of a uniform-temperature room



Above, greatly enlarged cross section of a photo cell. In the diagram below, light strikes the cell and generates an electric current, the path of which is shown in color. This current passes through the small moving coil which carries the instrument pointer and is pivoted to turn under the influence of a strong permanent magnet (shown outside it). The current passing through the moving coil interacts with the magnetic field of the permanent magnet and causes the coil to turn in proportion to the light

are matched so that the finished product will perform with the maximum efficiency. Again we find that, although the same principle is used, the method of manufacture varies slightly.

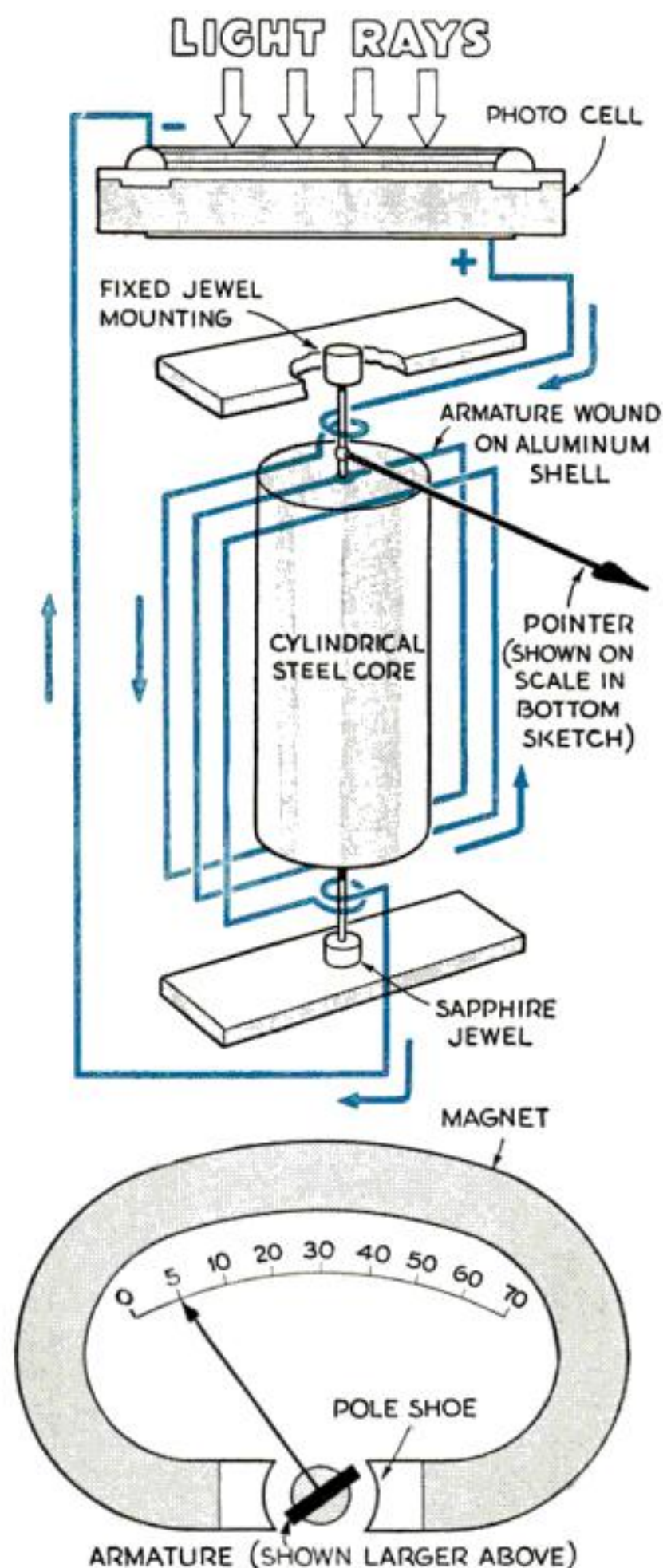
In the Weston plant, each part is cleaned with compressed air before being set in place. Each of the girls assigned to the assembly of the small parts has a hose through which air is sprayed to prevent foreign particles from clinging to any piece. In the General Electric plant, there is a suction system for removing dust, and uniform temperature is maintained by air conditioning. Here the girls all wear lintless white smocks as additional insurance against dust.

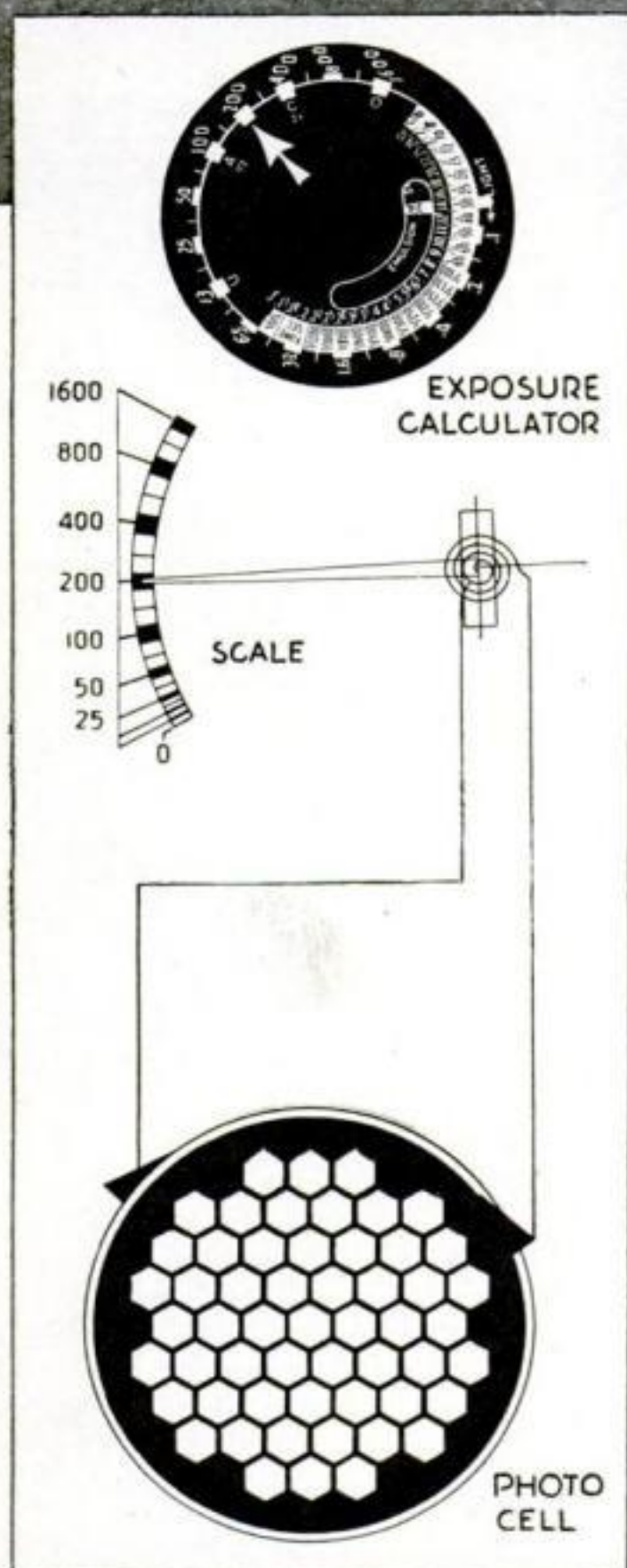
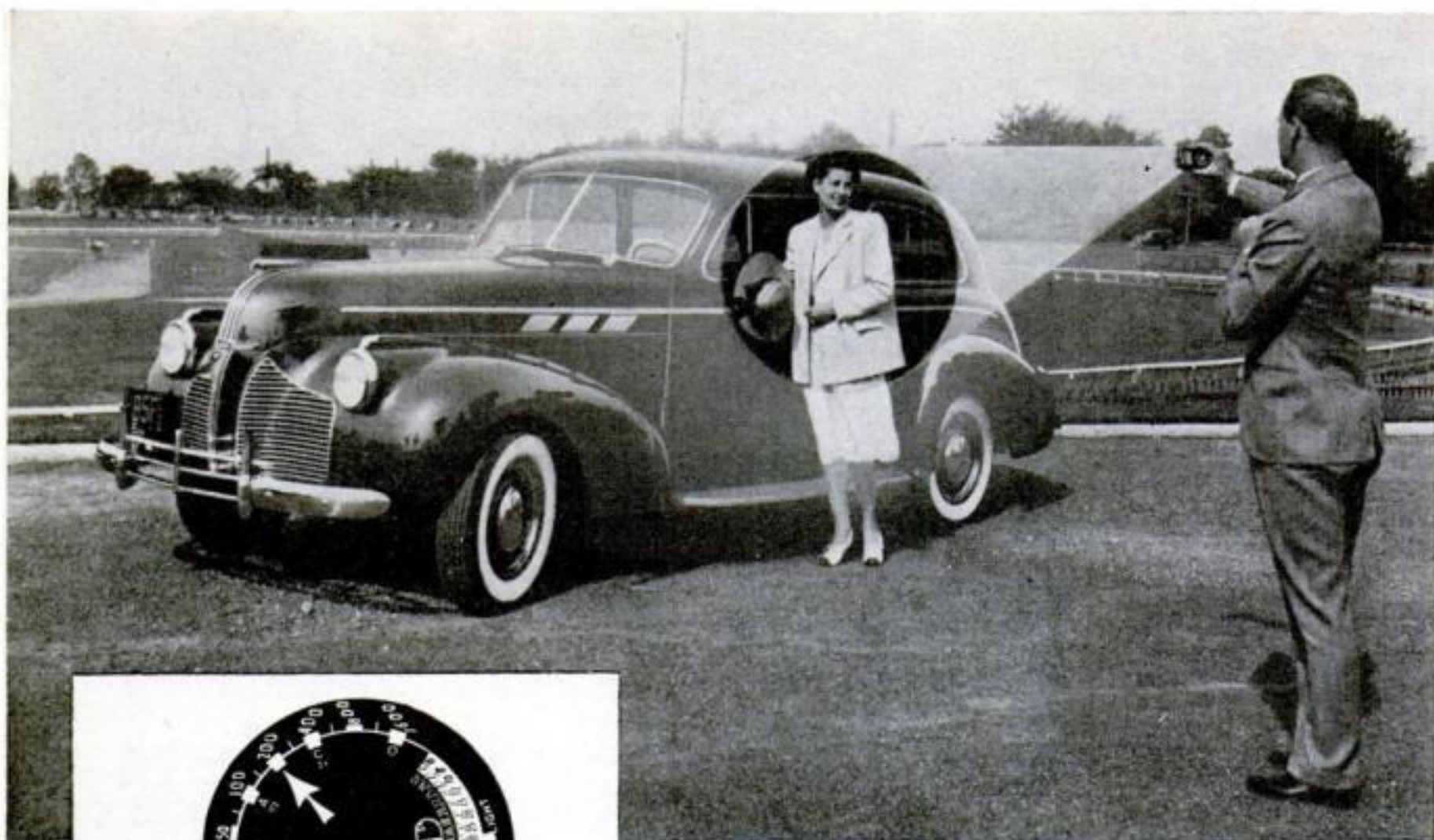
The Weston selenic cell is hermetically sealed in a separate chamber after it has been dried of moisture by baking. The G.E. cell is also baked, but it is sealed by a coating of transparent lacquer. The method of making electrical connections with the cells varies only in position and size. After the Weston cell has been inserted in its container, a honeycomb baffle is placed over it, then the multiple lens is set in place. The Weston engineers claim that this system provides the same or smaller angles of light gathered in by the camera lens.

The G. E. cell is inserted in its container and a ground glass is placed before it at a measured distance. A baffle with prescribed apertures in proper relation to the cell is then added.

On each meter there is a set of scale figures to give a visual reading of the brightness of the light. These figures are selected by the manufacturer, and each meter is calibrated according to the standards selected by the maker.

Meters are somewhat like automobiles; the quality of outstanding makes must be comparable. In the case of Weston and General Electric meters, not only the sele-





The meter measures light in the area shown in the circle. In this case the reading was 200, as in the diagram at left. The film had an emulsion speed of 24, Weston rating, so 1/50 second at f/11 was used

nium cells, but every piece of mechanism which is contained in the instrument is made by the manufacturer.

Although these meters have been built with every care and precaution against accidents, they are not beyond injury when subjected to unusually rough treatment. If either of these instruments is dropped upon a cement walk, it is possible that the case may crack. The cells cannot be damaged by an ordinary fall, but the lenses in either meter may crack. However, this damage may not necessarily prevent the meter from functioning. On the other hand, if the movable unit or indicating needle is harmed, the meter will cease performing accurately.

The readings of the different meters vary according to the calibrations of the manufacturers. The pointer moves according to the strength of light to which the cell is exposed and indicates on the meter scale the value of this light. The scale is calibrated according to light values. The photographer need only set the dial to this figure as against a certain emulsion speed, which in turn is supplied by the meter manufacturer, and then his exposure is determined. The calculator dials then tell the user the combinations of shutter and diaphragm stop that will give correct exposure.

Special apparatus has been designed to check and double check every rating given by the manufacturer. Air conditioning to produce scientifically measured temperature, and instruments for the timing of the processing are

only part of the extensive research being conducted by the engineers to produce a perfectly calibrated exposure chart in accordance with the emulsions now manufactured.

To supplement this explanation, study carefully the preceding diagrams, one of which shows how a meter operates and another, how it is used.

The photo exposure meter is an accepted instrument for measuring the light and translating the light the camera sees into terms of photographic exposures. If plans are executed for establishing one American rating system of speeds in emulsions, it will simplify matters for every camera owner who uses a photo exposure meter. According to our information, this plan is expected to materialize in the near future, and from then on we will have but one school of thought and that will be the All-American Standard.



At this instrument board—one of many used—the meter gets its first calibration

COPYING DATA CARDS

[PHOTOGRAPHY]

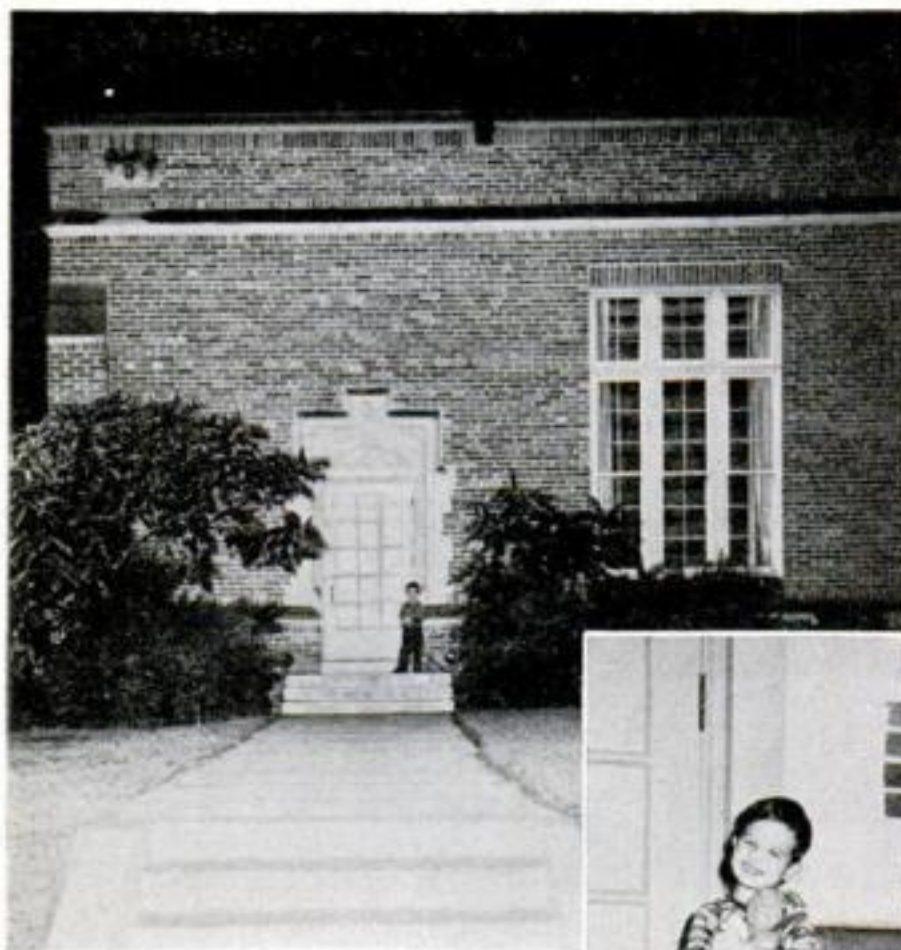
Obtain single-weight glossy paper (either contact or enlarging) of an extremely contrasty or "hard" grade. Lay this, sensitive side down, on the data card or portion of page to be copied. Place a sheet of glass over the paper and press or weight the glass along the edges so the paper makes absolute contact with page. Expose by means of an electric lamp placed a foot or more away so the light falls evenly on the back of the sensitized sheet. Develop fully for maximum contrast. A properly exposed negative barely shows the image of printing by reflected light and looks too dark, but the image is clear if viewed by transmitted light. Use this paper negative like any other to make a positive print. For filing purposes, use double-weight paper or post-card stock for the print, or mount it on a sheet of thin cardboard. This work must be done in a darkroom unless special paper intended for reflective copying is obtained. The special paper can be handled in subdued white light.

POPULAR SCIENCE MONTHLY SHOP DATA FILE



To copy a data card, a sheet of single weight glossy photo printing paper is laid face down on it, then covered with glass and exposed to an electric light. This must be done in a darkroom

Focusing Reflector

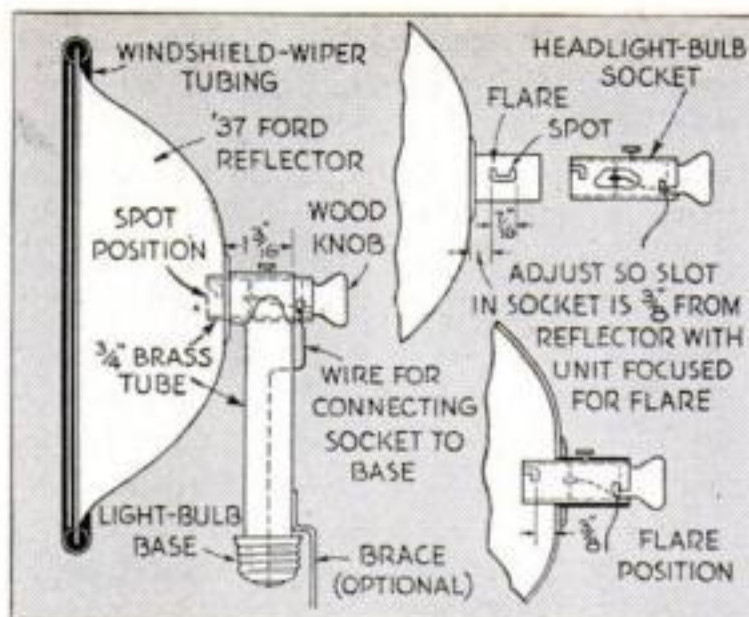


Even a night scene 60' away can be shot. Data: f/8 at 1/100 sec., No. 5 G.E. bulb

WITH this inexpensive homemade reflector, a photographer can take full advantage of midget flash bulbs. The reflector is focusing, giving a broad flare of light for close-up work and a powerful searchlight spot for distant action shots. When the reflector is set for "flare," one of the "peanut" bulbs more than equals a large No. 21 or No. 2. And in the "spot" position, the reflector makes it possible to take pictures over distances of as much as 100'.

Actual comparison tests with four different makes of commercial reflectors, including one costing over six times as much, proved that the reflector is from one to three diaphragm stops better than the small 5" reflectors and more than the equal of the large, expensive ones.

The first step is to solder into the reflector a $\frac{3}{4}$ " brass tube in which the tubular-shaped bulb socket slides. Next, a longer piece of brass tubing is notched and soldered on at right angles. This vertical tube terminates in a brass base taken from a burned-out electric light bulb or flash bulb. Before the base is soldered on, a wire is soldered to the center and run out through a hole in the tube.



Cost: 1937 Ford headlight reflector, 50 cents; socket, 10 cents; rubber tubing for trim, 8 cents; pieces brass tube, 6 cents



Close-up view. Exposure f/16 at 1/100 sec., same type bulb



The reflector allows focusing to be done simply by turning a knob

To provide for focusing, the tube carrying the tubular-shaped socket is slotted (by drilling a row of small holes and finishing the job with a spark-plug file) in the shape of a square-cornered "U." Then, before the socket is inserted in the tube, it is drilled and tapped to carry a machine screw, which moves in this slot and allows the socket to be locked in a position where the bulb is near the reflector (for distant shots) and farther away from the reflector (for "flare" shots). In the second position, the pin in the base of the flash bulb should be $\frac{3}{8}$ " from the back of the reflector. For "spot" flashes, the bulb pin is $\frac{7}{16}$ " farther in.

When the reflector is finished, it is trimmed with rubber windshield-wiper tubing, split and cemented on with china cement. The final step is to give the reflecting surface a coat of thinned lacquer. The back of the reflector can be painted.—WILLIAM L. BURKHARD and STANLEY JOHNSON.

Long Life for Your Films

By VERNON B. CASE

H EAT and moisture are the principal enemies of photographic film. So, whenever you store away negatives, positive motion-picture film, and black-and-white or natural-color transparencies, take special precautions to keep them cool and dry.

The simplest way is to seal the film in an air-tight glass or metal container and keep it in the basement or other cool place. Put film negatives in transparent envelopes or wrap them in Cellophane before storing them. If metal boxes are used, seal the lids with adhesive tape. Glass jars can be sealed with a rubber gasket under the lid.

Have the negatives thoroughly dry before sealing them up. Very little moisture is present on dry, cold, winter days, but in summer the hot, humid days will saturate the film and its wrapping with moisture. When facilities for artificial drying are not available, wrap the film as suggested and pack around it a quantity of good quality paper that has been dried thoroughly in an oven. Travelers in the tropics recommend ordinary rice, heated in the oven until it turns brown. Let it cool, and then place it in the container with the film and seal the lid with adhesive tape. You can put the rice in small cloth bags for ease in handling.

Silica gel is probably the best drying agent. This material has the chemical composition of sand and looks much like it, but is made in such a way that each grain con-



Oven-heated rice acts as a drying agent. Pack it around the film and seal container with tape

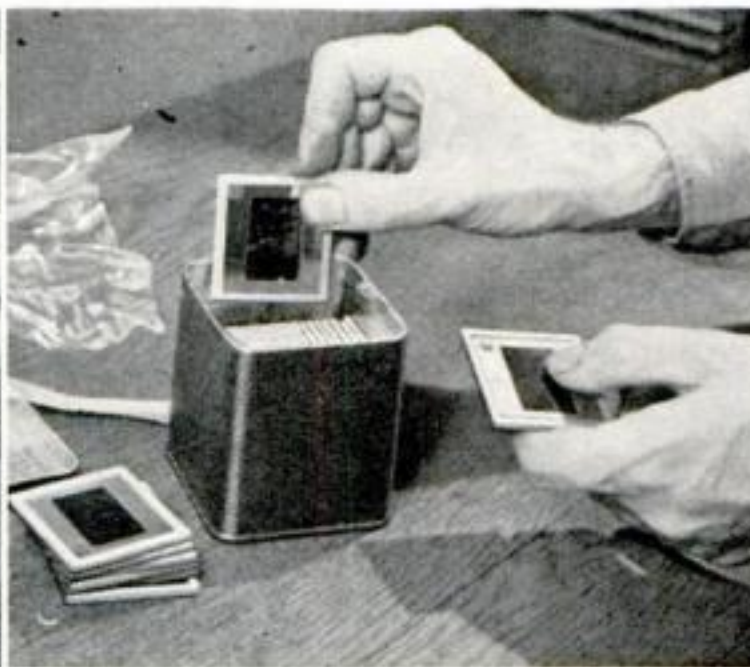
tains millions of tiny pores that suck up moisture better than any sponge. If the weather is humid, heat the gel in an oven to drive out any moisture, then put it into small cloth sacks that can be packed around the film envelopes or packages.

A moisture-absorbing unit or air dryer for photographic materials, as well as for lenses, optical instruments, and precision tools, is now being marketed. It consists of an aluminum box containing silica gel. The box is perforated to allow moisture to enter and has a mica window so the color of the gel can be seen. When activated, the chemical is blue; when saturated with moisture, it is pink. It lasts indefinitely and is easily reactivated by heating in an oven.

Check film storage containers occasionally to see if the drying medium is doing its work. If film and wrapping are damp, replace or rejuvenate the drying agent.



A small bag of silica gel, placed in a can with the film, will protect it from moisture in humid weather



Color transparencies will last longer if sealed against moisture and stored in a cool place. A small metal tea container will hold approximately thirty-six slides



An air dryer containing silica gel is now available. It occupies little space and may be reactivated by heat



Flash shot of dancer made with new lamp in $1/30,000$ second. Photo by Kaufmann-Fabry, Chicago, Ill.

Ultraspeed FLASH LAMP

DESIGNED for all types of ultraspeed photography, a new lighting unit is now available which opens the way for pictures of superb technical quality in either black and white or color. Known as the Kodatron Speedlamp, the unit is based upon the methods of high-speed photography developed by Dr. Harold E. Edgerton and his associates of the Massachusetts Institute of Technology. It utilizes a gas-filled, electri-

cally operated flash tube and provides a great volume of light, comfortable to the eye and well balanced for photographic purposes, at an effective flash speed of about $1/30,000$ second—800 times as swift as the wink of an eye.

The flash is accomplished by discharging a condenser through a gas-filled tube. Ordinary 115-volt, 60-cycle current is led into the power unit of the lamp, where a specially

constructed transformer steps it up to 2,000 volts. This current is then rectified and used to charge a condenser. When the trip circuit is closed, either by hand, by a flash synchronizer, or by a photo-cell unit, the energy stored in the condenser is discharged through the tube in approximately 1/30,000 second.

The flash lamp itself has a tubular frosted glass shell, although the one illustrated was purposely made with clear glass so the interior could be seen. The shell fits over a spiral glass tube, which contains a mixture of krypton and xenon gases. This is the flash element. The gas becomes heated to incandescence when the condenser charge is released through it. Centered in the coil of the gas tube is the modeling light, a small projection type bulb of moderate wattage and long life.

In spite of its apparent mildness, the single flash provides illumination equivalent to that of 40,000 tungsten lamps of the 50-watt size. This quantity of light is sufficient to provide a fully-timed negative of an average subject 50' from the camera at a lens aperture of f/11, when used with films especially recommended for this type of radiation. For color photography, professional Kodachrome film yields satisfactory results if used with moderate correcting filters that are soon to be regularly supplied. Correspondingly smaller lens apertures can be used when the subject is nearer the lamp or lamps.

The power unit is only 8" by 10" by 9". The 18" spun-aluminum reflector is mounted on a telescoping steel stand, which can be extended to a height of 8'. A small tray-top steel base with rubber-tired, swiveled casters serves as a carriage.

Controls are concentrated in a small panel on top of the power unit. These include the flash trip, off-and-on switch for the main power line, and a red pilot light to show when the unit is in operation. A single cable from the power unit to the reflector carries wiring for both the flash lamp and modeling light. The lamp cable and the 110-volt, 60-cycle electric supply cord plug into the sides of the power unit and must be removed before the hinged top can be lifted. This arrangement, plus an auto-

matic cut-out switch which functions as the power unit lid is opened, makes it impossible to touch a "live" connection.

Among the advantages of the lamp are critically sharp pictures of subjects moving at high speed; simple, positive synchronization with most types of camera shutters; and the ease with which any number of lamps may be flashed in unison by means of simple photo-cell control units, which eliminate the need of wiring from lamp to lamp. Great depth of field is possible because small lens apertures may be used. The volume of light is uniform at each flash, and there is said to be no practical deterioration as the flash tube ages. Each tube yields upwards of 5,000 flashes.

Brilliant as the illumination is, the lamp is free from the heat produced by conventional high-wattage studio lamps. This saves models from discomfort and enables perishable subjects, such as food displays, to be photographed. Because of the extreme brevity of the flash, there is no eye discomfort for subjects.

To insure accuracy of modeling, the modeling or focusing lamp is centered in the flash tube so that its angle of light is precisely the same as that of the flash. The modeling light also gives a faithful preview of the light balance.

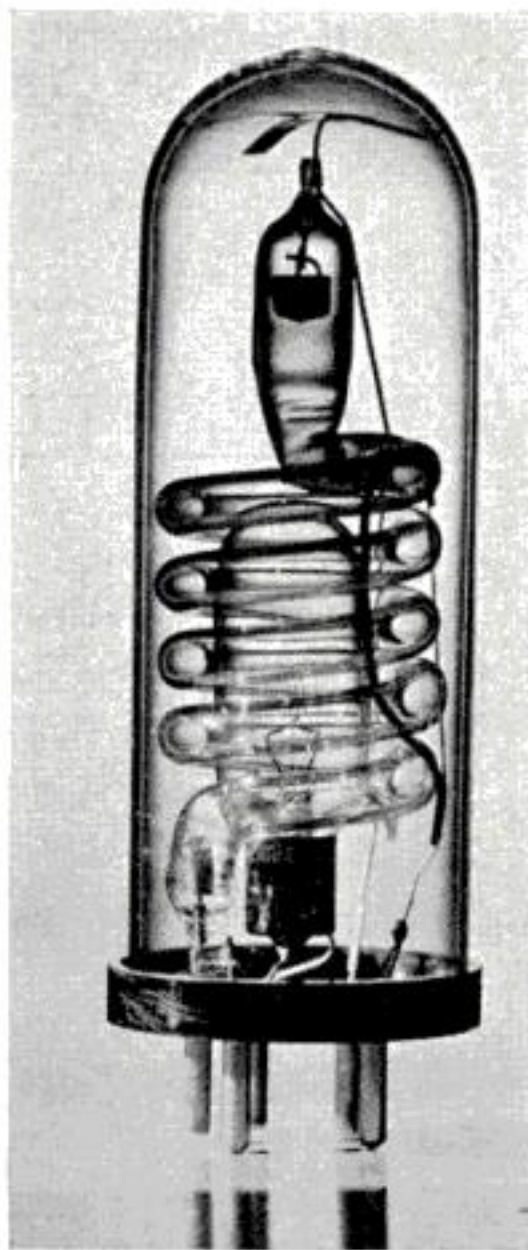
One feature of the improved lamp and circuit is its low power consumption, which effects a substantial two-way saving in lower electric bills and in studio wiring requirements.

With the new lamp, high-speed photography is no longer a laboratory stunt. For commercial and illustrative studios, it solves the three-horned dilemma of subject motion, field depth, and adequate illumination—especially in color photography. In the scientific, medical, and technical fields, its uses appear to be virtually unlimited, and it also has applications in portrait photography, whenever an apparently unposed, characteristic effect is desired, or when the subject is a child or unpredictable pet.

In photography with the new lamp, the time of exposure is fixed not by the shutter speed used, but by the duration of the flash. This is fast enough to stop virtually any

KODATRON FLASH TUBE

The spiral contains krypton and xenon gases. Centered in the spiral is a modeling light





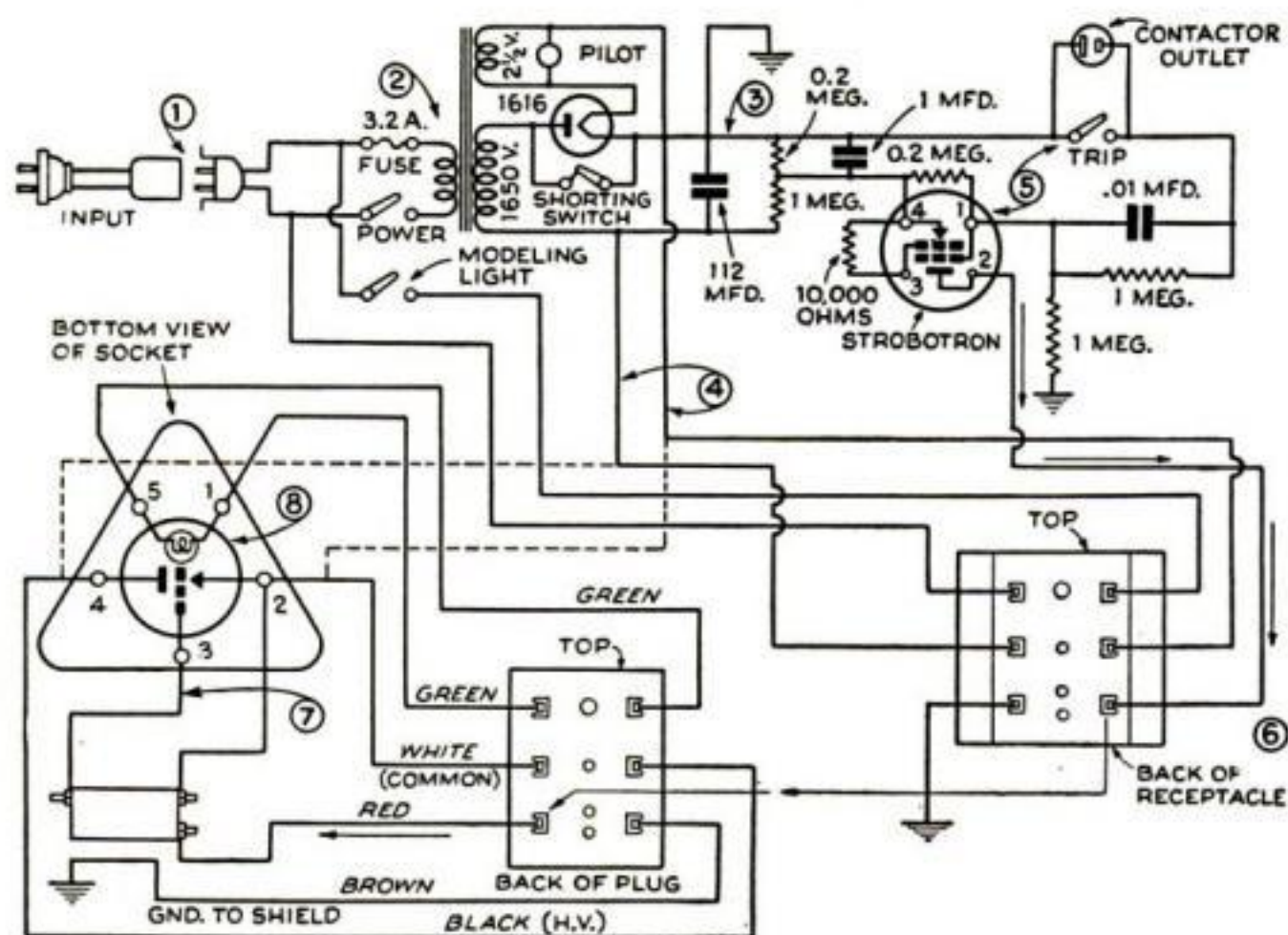
Water spurting from a dropped glass. The droplets appear to be "frozen" in mid-air

moving subject except a rifle bullet. If one second were represented as a mile, the effective duration of the flash would correspond only to about 2".

With the lamp, one flash can be made every ten seconds—this being the charging time of the condenser. The charging takes place automatically, and the ten-second period allows convenient time for changing film and resetting the camera shutter. Current consumption is quite small during the charging cycle—about five amperes at the start, decreasing in a few seconds to less than one ampere—and this explains the extreme operating economy. Two or three of the lamps can be operated safely on an ordinary house-lighting circuit fused for 15 amperes.

For assignments away from the studio, newspaper office, or other base of operations, the reflector and power unit alone may be used. Each power unit has a carrying handle on top.

As many lamps as desired may be flashed in synchronism, to cover large areas or to obtain better modeling. Two methods are practical. One is to use wiring from lamp to lamp; the other, to use small accessory photo-electric trip units, which clip directly to the lamp standard. A trip unit is used on each lamp except one, which is connected by wire to the camera shutter. The shutter-actuated flash of the first lamp then fires all the others. This method of synchronizing is particularly convenient when the set-up is extensive, or when lamp-to-lamp wiring would be in the way.



How the Kodatron Speedlamp functions. 1. The input is 115 volts, A.C. 2. Transformer steps it up to about 2,000 volts; rectifier converts it to D.C. 3. Main condenser charges at 2,000 volts in 10 seconds. 4. Wiring to flash-tube electrodes. 5. When trip is pressed, an arc takes place in the strobotron tube. 6. This allows current to flow to special high-ratio coil. 7. Secondary of coil transmits high voltage to flash lamp. 8. This ionizes gas inside flash tube and allows main condenser charge to flow between the electrodes

The complete lamp with its base weighs 59 lb. Controls are located at top of the power unit



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12,000,000 SUCCESSFUL SNAPSHOTS
AT NIGHT



YOU may not have discovered it yet, but you're every bit as good a snapshooter by night as you are by day.

Just be sure to use Kodak Super-XX Film—it's about four times as fast as ordinary film—and your very first batch of snapshots indoors after dark will be quite as good as the pictures you've been getting outdoors in sunlight.

And you don't need an expensive camera, either. Any camera that takes Kodak Super-XX Film will do, even a \$1 Baby Brownie.

Night Snapshots simple as A.B.C. with
KODAK SUPER-XX FILM



A... Load your present camera with Kodak Super-XX Film.

B... Use a couple of inexpensive Mazda Photoflood lamps in Kodak Handy Reflectors. (You keep your Reflectors, folded flat, in their attractive box. Kodak Handy Measure included.)

C... Follow the few simple directions in the FREE Booklet. Like shooting with an expert at your elbow. Brief, easy-to-follow instructions and diagrams, exposure table, picture suggestions. At your dealer's . . . Eastman Kodak Company, Rochester, N. Y.

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Flash Bulbs and Apparatus Checked by New Tester

PHOTOGRAPHERS are able to test their flash equipment with a device recently marketed. An inclosed resistance allows the instrument to test the flash bulb without firing it. The bulb is placed as shown; if the bulb is good,

the small light will glow when a small button on the side is pressed. The device fits any flash gun and may be used for testing the batteries and the synchronization of the gun.



Note tiny bulb in tester which glows if a bulb is good

Kodachrome Transparencies Filed in Dustproof Case

A STURDY, all-metal, dustproof case for indexing and filing 150 slides is now being offered as a solution to the problem of storing and carrying miniature black-and-white or Kodachrome transparencies. Outside dimensions are 2" by 7¾" by 14¼". The case comes in an attractive gray crackle finish and has a handle for carrying.





NEW GLUE DISCOVERY

brings modern resin-bonding
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THE biggest news in glue since Casco Powdered Casein! *Cascamite* brings you as great an advancement over casein glues as Casco brought you over all other glues 10 years ago! Look at *Cascamite's* advantages:

EASY TO MIX—*Cascamite* dissolves almost immediately in cold water. No waiting, no heating. Easier, simpler than mixing Casein.

STRONG—Shear tests on hardwood prove *Cascamite* is stronger than the wood, even after prolonged water soaking.

WATERPROOF—*Cascamite* is completely waterproof. Safe for boats, all outdoor construction.

DURABLE—*Cascamite* joints are inert, unaffected by mold. Makes joints that withstand any climate.

STAINFREE—*Cascamite* is non-alkaline, won't discolor the thinnest of veneers. Won't stain oak, mahogany, etc.

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ECONOMICAL—*Cascamite* costs more than casein *per pound*, but it is spread *thinner*. When extended with flour, *Cascamite* costs no more than casein.

Cascamite is *reliable*. It is made by Casco, manufacturers of industrial glue for over 30 years... makers of Casco Powdered Casein Glue... America's pioneer in development and manufacture of synthetic resin glue. *Cascamite* is sold by all leading Hardware, Paint, Lumber Dealers. ½ lb., 50¢; 1 lb., 85¢.

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58,279 Pipe Smokers are still missing!

Among hard-to-please pipe smokers a high percentage naturally enthuse about BOND STREET. Applying this percentage we know that about 58,279 pipe-smoking readers of this magazine—for whom BOND STREET is a “natural”—still have this grand discovery to make.

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It contains a rare aromatic tobacco not hitherto used in a popular price mixture. Rich-tasting, bite-free—leaves no tobacco odor in the room—even the ladies approve.

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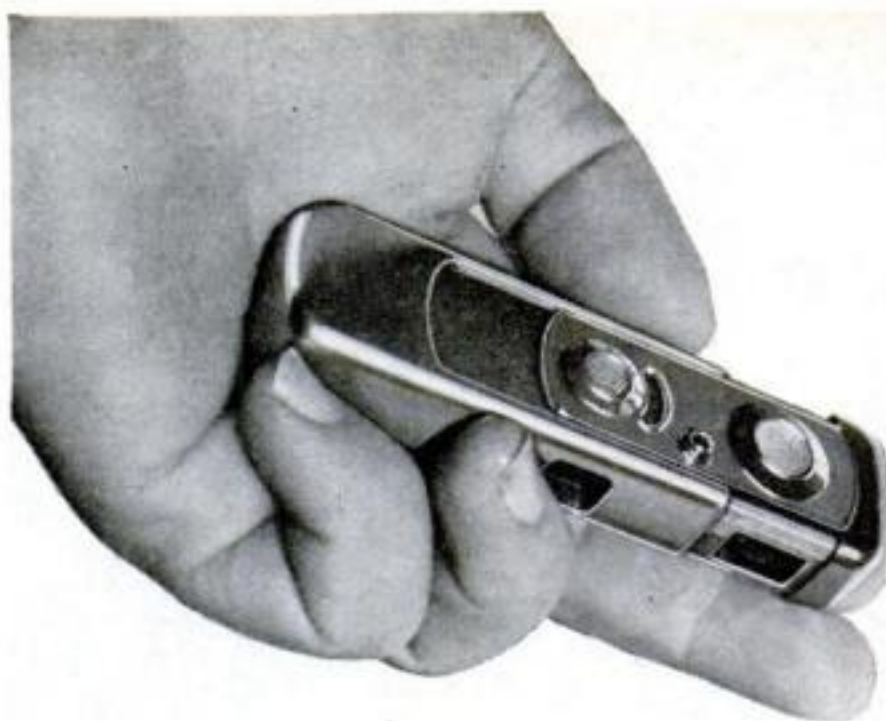
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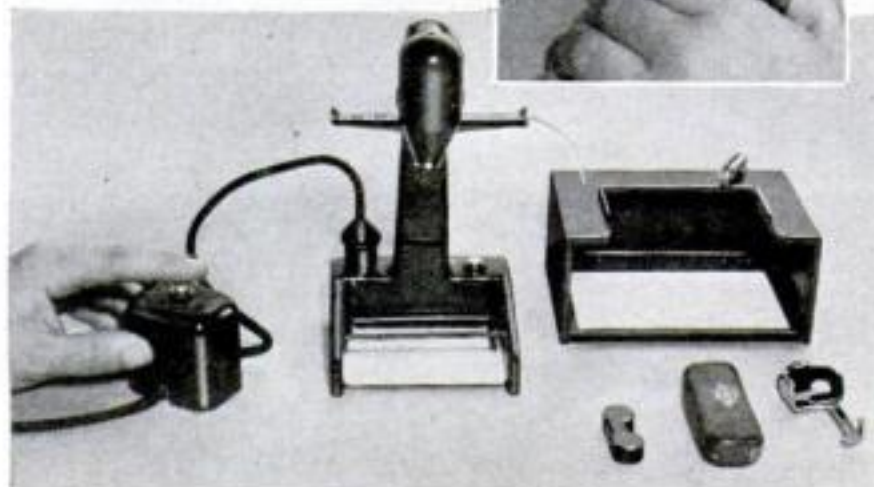


Tiny Precision Camera Takes Thousandth-Second Pictures

A CAMERA that fits in the palm of the hand is the latest offering for the miniature camera fan. Measuring only $19/32$ " by $1\frac{1}{16}$ " by $3\frac{1}{8}$ ", this precision instrument has all the features that most larger cameras have, and more, such as fully corrected f/3.5 anastigmat lens, parallax corrected view finder, critical focus from 8" to infinity, depth-of-focus scale, shutter speeds from $\frac{1}{2}$ to $1/1000$ second, automatic film counter and transport, and a built-in filter for outdoor scenes. Film is supplied in a special daylight-loading cartridge of fifty exposures. The size of the frame is 8 by 11 mm.

Among the accessories for the camera is a fixed-focus enlarger which enlarges the tiny negatives to post-card or to half post-card size. The enlarger easel has an automatic mask operated by a button. The developing tank uses $1\frac{1}{2}$ oz. of developer and does not need a darkroom.

Right, film cartridges fit in a daylight developing tank. Enlarger and accessories shown below



Atlas TOOLS OF INDUSTRY

For Personal Craftsmanship

Fortunate is the mechanically minded man who has a natural skill in working with tools. His greatest satisfaction comes from developing that skill to its highest point—precision work in metal. These Atlas machine tools help realize such an ambition. They are soundly engineered, modern in every construction detail, and easy to operate.

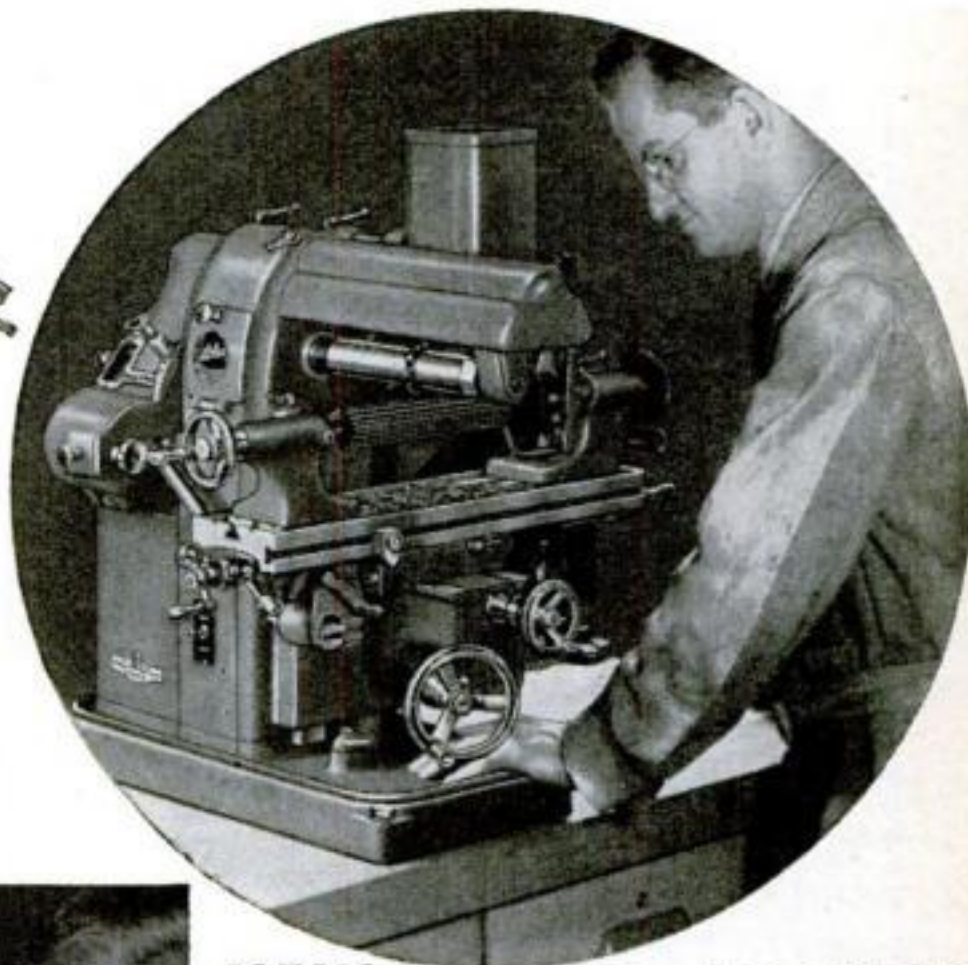


10" — 6" LATHES

Industrial tool rooms, metal working shops, and workshop owners throughout the world praise the versatile operating features, accuracy, and sensible low prices of Atlas Lathes. Ask your dealer to show you the 10" lathes as low as \$107 less motor, and 6" lathes as low as \$66.50 less motor.

DRILL PRESSES

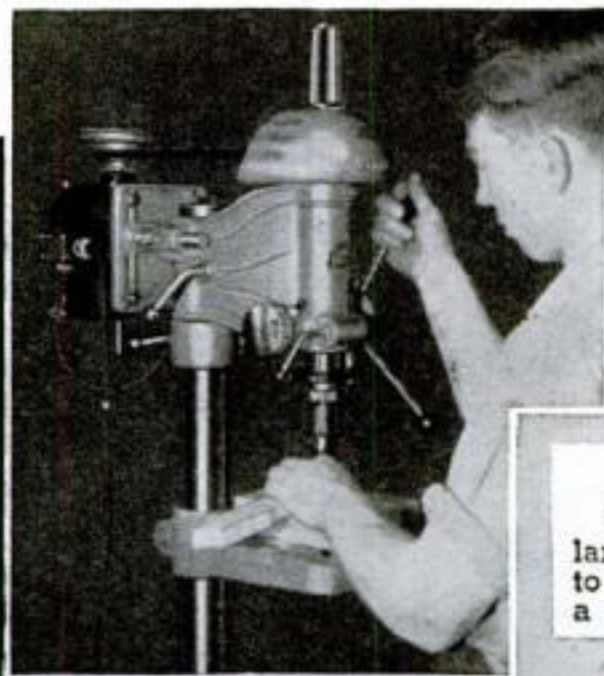
Atlas "floating drive" spindle design with SKF ball bearings gives you a drill press that is famous in industry for smooth operation and dependable accuracy throughout its long service life. There are models to suit every purse and purpose priced from \$18 to \$47. Ask your dealer and send for the new 1941 Catalog for details.



NEW MILLING MACHINE

For the first time in history you can now buy a compact precision bench Milling Machine as low as \$205 to handle the full range of milling work from slabbing and facing cuts to end milling, keyway cutting, finishing, and layout work. It's the machine tool sensation of 1941! Be sure to read about it in the new Atlas Catalog.

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| <input type="checkbox"/> Arbor Presses | <input type="checkbox"/> 7" Metal Shaper |

Name

Address

City and State

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Precision and power of larger machines built down to scale for everything within a 7" stroke. \$265 less motor.





**Skilled hands
deserve
skilled tools**

DESPITE the wonders of mechanized production, this machine age still has thousands of jobs which require tools that respond to the trained human touch. Die-sinkers, model makers, instrument finishers can do their best work only when their precision files are *right for the job*—in shapes, sizes, cuts and *quality*.

Such files require the *precision manufacture* which only long experience and ample facilities can assure. You'll find it in Nicholson X. F. (Extra Fine) Swiss Pattern Files. Points are smaller, tapers longer, cuts finer than in the conventional "American Pattern" files. Cleaning out, burring, enlarging small holes, shaping and finishing extra-narrow grooves, slots, notches, keyways are more accurately accomplished.

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Some Nicholson X.F. Swiss Pattern Files



NICHOLSON
FILES FOR EVERY
PURPOSE



Early American Interiors Reproduced in Miniature

PICTURESQUE Colonial rooms are easily re-created in minitature with a new kind of construction kit recently announced in this magazine (see P.S.M., Nov. '40, p. 206). Two of these kits are now available—one is for a kitchen. (kit No. 13) and the other is for the tavern taproom (No. 14) shown above—and the price is only \$2.00 apiece.

Each kit contains walls, ceiling, floor, and fireplace printed in four colors on heavy cardboard; thin wood from which can be jig-sawed the flat pieces for table, bench, and chair; turned chair rungs and uprights, finished metal parts, and miscellaneous odds and ends for completing the scene. Each room is 21" long, 7" high, and 5" deep.

Kits are also available for building ship models and whittling novelties.

STANDARD SHIP MODEL KITS

- | | | |
|------|---|---------|
| A. | Whaling ship WANDERER, 20½" hull, 27" over all | \$7.40* |
| D. | Spanish galleon, 24" hull, 30" over all..... | 6.95* |
| E. | Battleship U.S.S. TEXAS, 3' long..... | 7.45* |
| G. | Elizabethan galleon REVENGE, 25" hull, 28" over all..... | 7.25* |
| L. | Farragut's flagship HARTFORD, steam-and-sail sloop-of-war, 33½" hull, 41" over all | 8.45* |
| Q. | Privateer SWALLOW, a Baltimore clipper, 12½" hull, 20" over all..... | 4.95† |
| V. | Clipper SOVEREIGN OF THE SEAS, 20½" hull, 26" over all..... | 4.95† |
| 2S. | U.S. Navy destroyer PRESTON, 31½" long | 5.95* |
| 3S. | CONSTITUTION ("Old Ironsides") 21" hull, 31" over all..... | 6.50* |
| 4S. | Clipper ship GREAT REPUBLIC, 31½" hull, 42" over all..... | 8.40* |
| 5S. | Coast Guard Patrol of 165-ft. type, 20½" long..... | 4.95* |
| 6S. | Brig MALEK ADHEL, 20" hull, 33" over all; frame-and-plank construction..... | 9.75† |
| 8S. | Fishing schooner BLUENOSE, 17½" hull, 22" over all..... | 4.95† |
| 9S. | New Bedford whaleboat, with complete equipment, 14" long..... | 2.75† |
| 10S. | Confederate raider ALABAMA; steam sloop, bark rigged; 21½" hull, 28" over all..... | 8.20* |
| 11S. | Revenue Marine Cutter JOE LANE, a top-sail schooner, 13½" hull, 21" over all (Kit contains precision-shaped hull and finished blocks, deadeyes, belaying pins, etc.)..... | 7.00† |

MODEL-OF-THE-MONTH KITS

- | | | |
|----|---|--------|
| M. | Aircraft carrier SARATOGA, 18" long..... | \$1.00 |
| N. | Convoy of four U.S. destroyers, for aircraft carrier, each 6¼" long | .75 |
| R. | U.S. cruiser TUSCALOOSA, 11¼" long..... | 1.00 |

(Continued on page 218)



HAROLD F. HUNT
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1941

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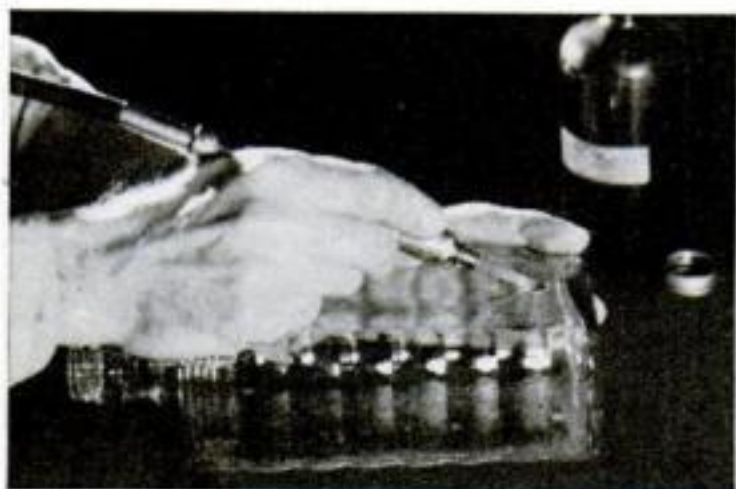
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Kits for Building Models

(Continued from page 216)



A model of the stately clipper "Great Republic" can be made with our kit 4S. It is 42" over all

- U. HISPANIOLA of the book and movie "Treasure Island." 7" long..... .50
- Z. H.M.S. BOUNTY, 8½" hull, 11½" over all.... 1.50
- 6M. Fishing Schooner WE'RE HERE of "Captains Courageous," 9½" over all..... .75
- 7M. Fleet of nine modern U.S. fighting ships, including superdreadnought, light cruiser, aircraft carrier, submarine, and five destroyers; scale, 1" equals 100'..... 1.50†

SIMPLIFIED SHIP MODEL KITS

- F. Liner S.S. MANHATTAN, 12" long\$1.00
- H. Cruiser U.S.S. INDIANAPOLIS, 12" long.... 1.50
- J. Clipper SEA WITCH, 9½" hull, 13" over all 1.50

MISCELLANEOUS

- 7. Whittling kit with two shaped blocks for making sea captain 5½" high\$1.50
- 8. Whittling kit for six different Scotties; each is 2" by 2¼", sawed to shape..... 1.00
- 10. Copycraft whittling kit for making one of several Hobo Hank novelties. Includes master model 5¼" high..... 1.50
- 12. Marionette kit for making a model of Dopey the Dwarf, 9" high. Ready to assemble..... 2.25†
- 13. Miniature Early Colonial kitchen 21" long, 7" high, and 5" deep; walls, ceiling, and floor printed in four colors on heavy cardboard; with materials for furniture and finished fittings 2.00
- 14. Early Colonial tavern taproom (see Kit 13 for general description) 2.00

Note: If you live west of the Mississippi River, add 50 cents to prices marked with an asterisk (*) and 25 cents to prices marked with a dagger (†).

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You save the C.O.D. charge by sending your remittance with this order. Remit by money order, check, or registered mail. This offer is made only in the United States. Also see note above.

New Delta Lathe for Wood and Light Metal Turning

Inside Secrets of Delta Quality "Acme Threading"

The Acme threads used on certain Delta machines are another extra quality feature, often overlooked, that assures better work from power tools.



Ordinary Machine Thread



Acme Thread

On an ordinary machine thread, the top and bottom of the grooves and ridges are sharp. This type of thread is accurate enough for use on certain places such as

on lathe spindles where the actual face plate is screwed on.

But in other places, as in a circular saw arbor where the blade is not threaded and where the blade is held on by a nut, the ordinary machine thread is not accurate enough. There you will find Delta uses "Acme" threads.

In an Acme thread, the top surface of the thread is flat—accurately ground by precision grinding to a true diameter on which the saw blade fits—thus making the saw run absolutely true. This is impossible with the ordinary machine thread which permits the saw blade to ride on only a very thin knife-like edge. Moreover, this thin knife-like edge of the ordinary machine thread cannot be kept absolutely true and round, a condition which is necessary for true accurate work. Acme threads have more "heft"—are a stronger thread. They are used exclusively on all heavy industrial machines. Another advantage of Acme thread is that the side of the groove is steep so that in the case of a saw arbor, the nut has a better bearing surface and this holds the saw blade more securely. Acme threads are another of the many exclusive Delta features, which mean that dollar for dollar you get much more in Delta machines. Before purchasing a circular saw—check it carefully to be sure you are getting this extra quality that you should have.



Swings 12" Over Bed 37" Between Centers

• This No. 1465 Delta 12" Ball Bearing Lathe is designed to give you the biggest amount of *real* lathe for the least money! It has many splendid features including: Rigid, fine-grained cast iron bed with accurately machined ways; Improved, convenient Self-Indexing device; Lubricated-for-life sealed ball bearings; Universal Tool Support, rigid yet easily adjustable; Full 1 1/4" spindle with 5/8" hole; 4 speeds for wood turning or 16 speeds for metal work (with simple counter shaft arrangement); Inboard and outboard spindles threaded to take face plates; Efficient, powerful V-Belt drive; Safety headstock with covered belt and pulley. Also available is new 11" Delta lathe with cast-iron bed. For the complete story of these outstanding lathes, fill out coupon below.

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Blueprints Solve the Problem of What Projects to Make

WHAT shall I make next? This is a question that occurs over and over again in the home workshop, and for nearly two decades POPULAR SCIENCE has been helping its readers solve the problem. If you are going to be near water next summer, now is the time to start building a boat. Or perhaps you would like to construct a piece of furniture, or a radio, or a toy for the children, or a ship model. A few suggestions for things to make are given below; a complete list of available blueprints will be sent free upon receipt of a self-addressed, stamped envelope.

MODELS

Barbary Pirate Galley or Felucca, 20" long, 44-45-R	.75
Barnegat Lighthouse, 10 1/2" high, 298A	.25
BLUENOSE, famous fishing schooner, 17 1/2" hull, 110-111-112-R	1.00
Clipper Ship GREAT REPUBLIC, 31 1/2" hull, 272-273-274-R	1.25
Clipper Ship SEA WITCH, 9 1/2" hull, 219	.25
Concord Stagecoach DIAMOND TALLY-HO, 20 1/2" long, 115-116-117-R	1.00
Confederate Raider ALABAMA, 21 1/2" hull, 335-336-337-R	1.50
Elizabethan Galleon REVENGE, 21" hull, 206-207-208-209	1.00
Fishing Schooner WE'RE HERE of "Captains Courageous," 9 1/2" over all, 351-R	.50
H. M. S. BOUNTY, 8 1/2" hull, 254	.25
Liner QUEEN MARY, 10 1/4" hull, 283	.25
Miniature Fleet of Nine Modern U. S. Fighting Ships (full-size plans and instructions in booklet form), 372-R	.50
NOURMAHAL, power yacht, 8 1/4" hull, 276	.25
Ocean Freighter, 14" hull, 271	.25
Revenue Marine Cutter JOE LANE, topsail schooner, 13 1/2" hull, 374	.75

FURNITURE

Bedside Cabinet, with automatic light in top drawer; also Fireplace Screen and Trinket Box, 389A	.25
Bookcase for Holding Copies of Popular Science Monthly, 353A	.25
Double-Decker Bed, 277A	.25
Early American Round-Top Stand, 191A	.50
Fireside Bench, Colonial, 187A-188A	.50
Floor Lamp, with tripod base, 243A	.25
Four-Leaf Card or Occasional Table, 239A	.25
Hanging Wall Cabinet, 9 1/2" by 24" by 41 3/4", 280A	.25

(Continued on page 222)



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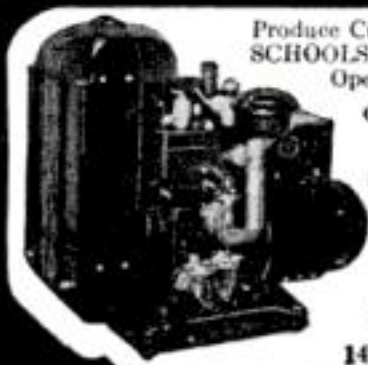
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Blueprints for the Shop

(Continued from page 220)

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Silverware Chest on Stand, 256A.....	.25
Smoking Stand, modern, 238A.....	.25
Tea Wagon, with removable tray and drop leaves, 20" by 30" top (turning), 13.....	.25
Upholstered Stool, 240A.....	.25

BOATS

Cabin Cruiser, 17' long, for use with outboard or inboard drives, 356-357-358-359-R.....	1.50
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Canoe, 16' canvas-covered kayak; can be used with sail, 192-193-194-R.....	1.00
Canvas-Covered Duck Boat, 13' 6" long, 279-R....	.50
Family Runabout, 13' 5½" long, weighs 275 lb., for outboards from 1 to 60 h.p.; can also be rowed, 378-379-380-R.....	1.50
Fisherman's Outboard Boat, 9' 3" or 11' 6" long, weighs 115 or 160 lb., for motors from 3 to 16 h.p.; can also be rowed, 344-345-R.....	.75
Inboard Boat, 15' long, for motors from ½ to 5 h.p.; can also be rowed, 384-385-R.....	.75
Lapstreak Skiff, 13' 9" long, weighs 225 lb., for 1- to 16-h.p. outboard motors, 363-R.....	.50
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Motorboat-Rowboat, 13' long, decked hull, for use with outboard or inboard drives, 147-R.....	.50
Same, 14½' long, 148-R.....	.50
Same, 16' long, 149-R.....	.50
Plywood Dinghy, 9' 7" long, weighs 60 to 75 lb.; can be rowed, sailed, or used with small outboard motor, 387-388-R.....	.75
Racing Runabout, 13' stepless hydroplane for outboard motor, 261-262-R.....	.75
Racing Sailboat BLACKCAT, 13' 4" long, weighs 250 lb., Marconi rigged, 321-322-323-R.....	1.00
Sailboat, 12' long, weighs 200 lb.; has fast skimming-dish hull, 314-R.....	.50
Sectional Rowboat, 9' 8" long, two sections, weighs 60 lb., all-wood construction; can be used with small outboard motor, 340-341R....	.75

MISCELLANEOUS

Aluminum-Trimmed Cheese Tray, Letter Opener, and How to Make Concrete House Numbers, 390A.....	.25
Baby's Crib and Play Pen, 26.....	.25
Birds and Animals, jig-saw patterns, 56.....	.25
Colonial Design Doll's House, 72.....	.25
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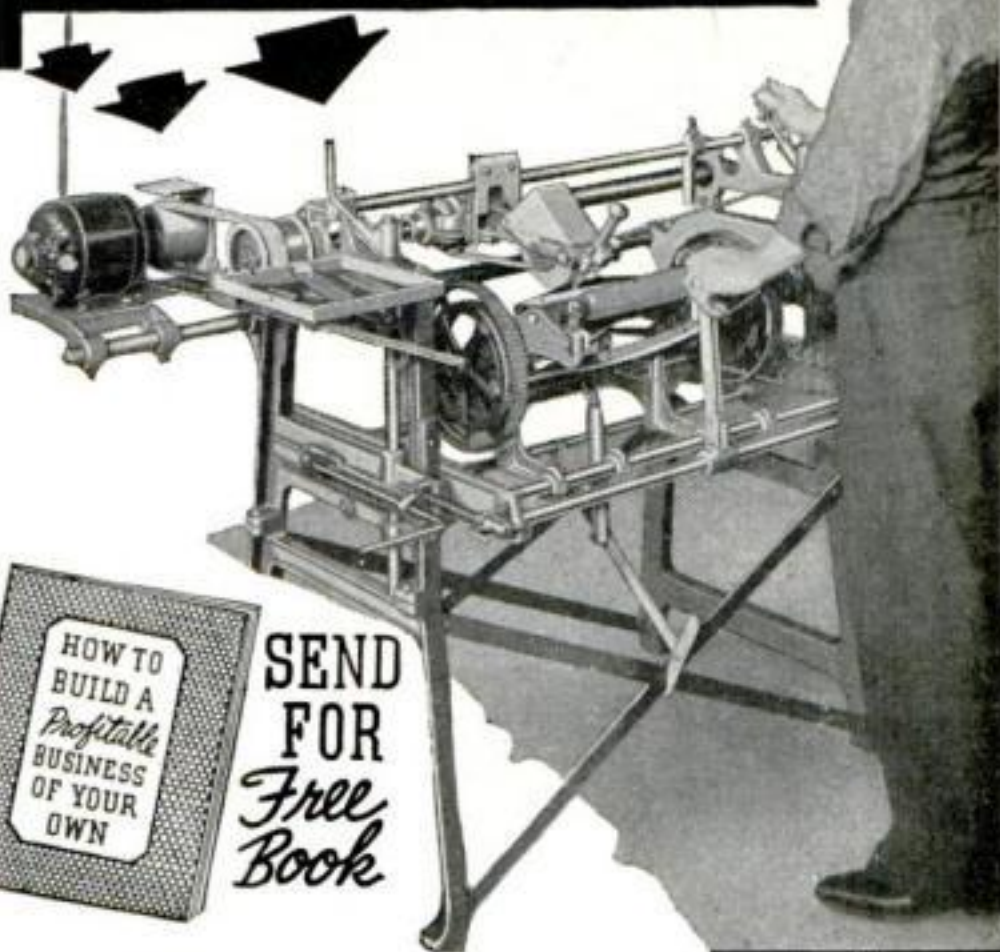
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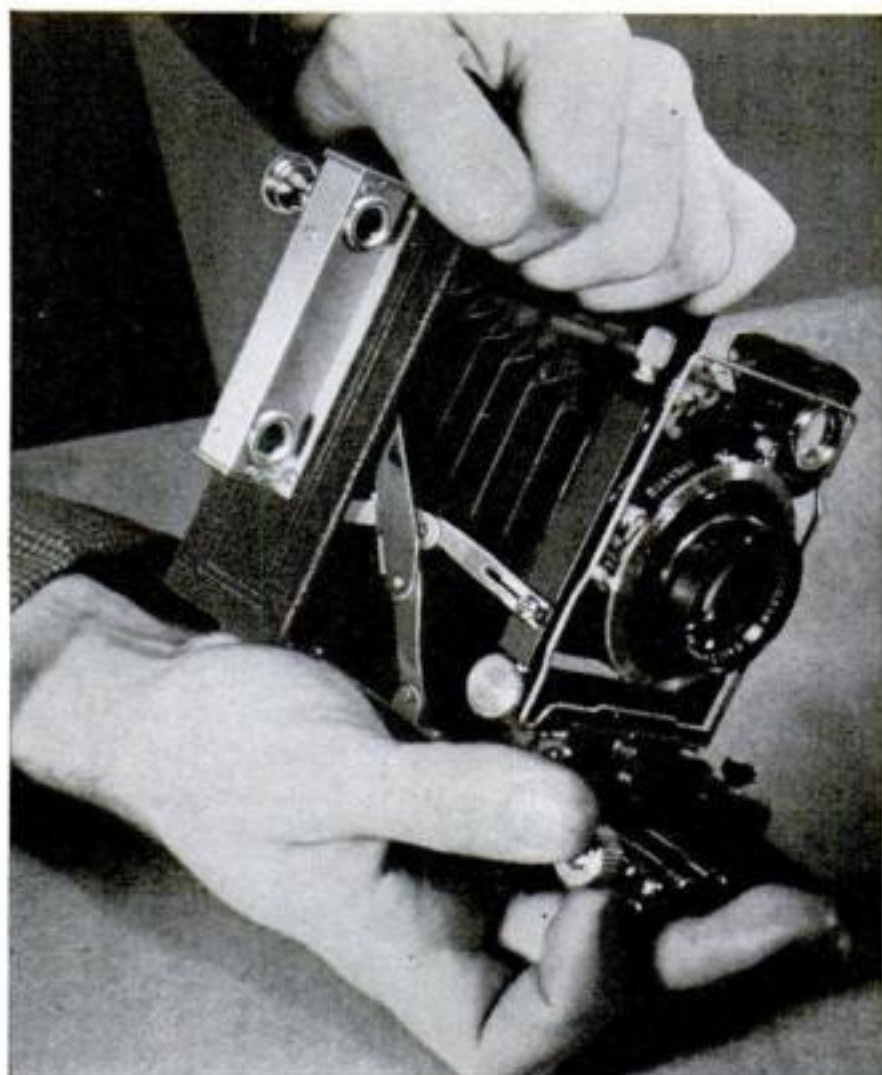
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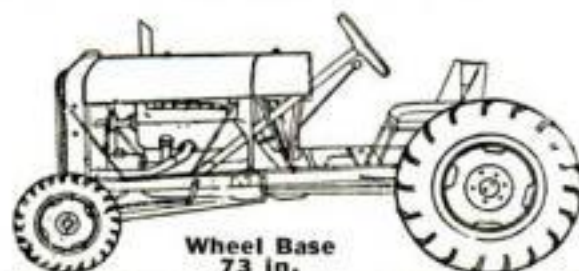
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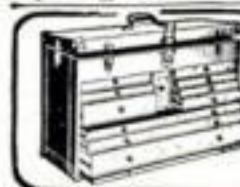


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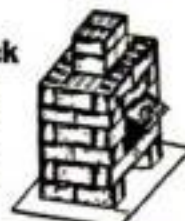
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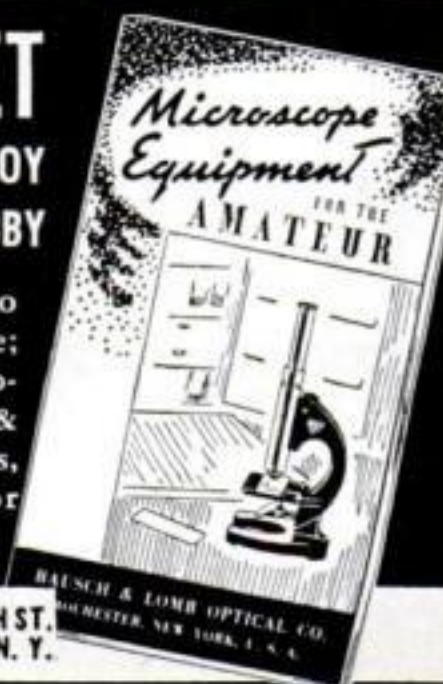
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Dramatizing Photography

(Continued from page 195)

low-cost shoes for half of the world before the country was invaded. In the last two years he has found more and more of his work interweaving with the general subject of national defense and the armed forces. This, he says, has been fascinating work, although the government requirements of secrecy and censorship have made his task triply hard.

Kessel takes all this pretty well in stride, perhaps because his early career was so much more startling. Born at Kiev, in the Ukraine, he went to military school and was commissioned as a junior lieutenant in the army at the ripe old age of 16 years.

He fought on three sides in the turbulent succession of civil and foreign wars which wracked old Russia between 1918 and 1920. It was no choice of his, but each successive government called up all trained officers in his region, and as a man with a normal respect for law and constituted authority, he obeyed, even though it got a bit confusing toward the end. He finally made his way to the United States in 1923.

One word of caution is required—Kessel would hate to think he was encouraging any young hopefuls to believe that they need only take a course in order to achieve success and comparative affluence. What he learned from his course was the solid technology of his trade—printing and processing. Composition and the feeling for a picture are still pretty much a matter of artistic instinct and inspired guesswork, he'll tell you.

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Trial by Mud

(Continued from page 129)

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More Miles a Gallon

(Continued from page 125)

In 1930, average compression ratios had reached five to one, and Ethyl's Bartholomew made the startling prediction that by 1940 car engines would have compression ratios of possibly six or seven to one. Experimental engines of the type were then being driven successfully at the Ethyl laboratories. The fuel used, while having higher antiknock value than any then commercially available, he declared, would "very possibly be developed for general use."

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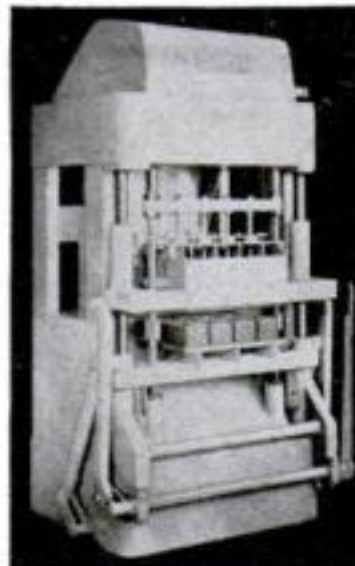


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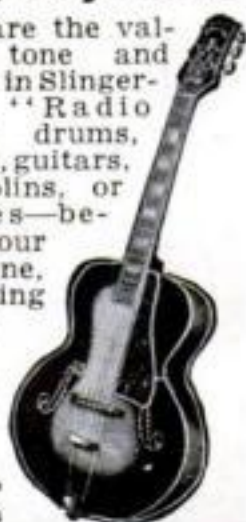
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Air-Raid Safeguards

(Continued from page 98)

The design of smaller shelters is also being taught at the Institute. They are not secure against direct hits, but are protection against flying bomb splinters.

Demolition bombs range from 250 to 1,000 pounds each. Some explode when they hit. Others have delayed action, permitting them to pierce before exploding. A 500-pound delayed-action bomb, for instance, can penetrate $4\frac{1}{2}$ feet of concrete before exploding. As the name indicates, demolition bombs are designed to demolish buildings.

The most common type of incendiary bomb weighs two pounds and consists of a composition of magnesium and thermite, an intensely burning metallic mixture which consumes almost everything it touches. Though light in weight, these missiles, dropped from 10,000 to 20,000 feet, will rip through several stories of a wooden structure. The cheapest and most practical way to douse them is to smother them with sand or to heave them to a safe place with a long-handled shovel. The shovel handles, incidentally, should be swathed in wet blankets for protection against heat.

Another kind of bomb is the fragmentation bomb, weighing from 25 to 50 pounds, which explodes when it strikes, sending steel splinters and shrapnel flying through the air. Its purpose is to destroy military personnel or, when used against a nonmilitary objective, to break civilian morale by spreading death and injury.

For overanxious civilians, experts give these tips on emergency measures:

Don't rely too much on subways as shelters. They're good if the tubes are far below the surface, but many of them have only a comparatively thin crust above them and would be doubly dangerous if a bomb crashed through the crust.

Perhaps the safest place in a large city during an air raid, outside of a bomb shelter, would be the middle floors of a skyscraper. If the building were hit on top, only the top portions would be blown off. If it were hit at the base, parts of several floors might be wrecked, but the framework and middle floors would stay put.

The best thing a civilian can do if fragmentation bombs start falling when he's outside a shelter is to lie on his face. Bomb splinters have a tendency to fly upwards.

But the best tip is this: Don't fret too much about the future. The military forces and their civilian aides are working hard to be sure that *you* get the maximum safety in time of war.

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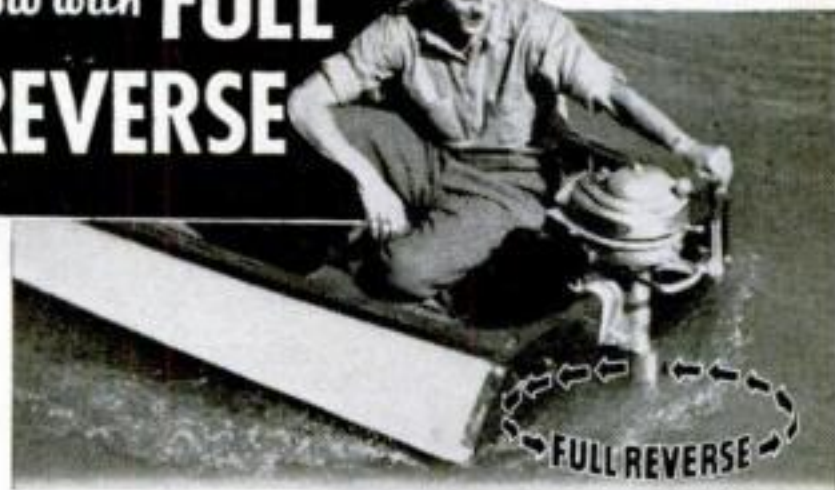
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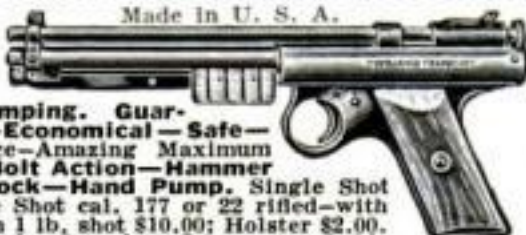
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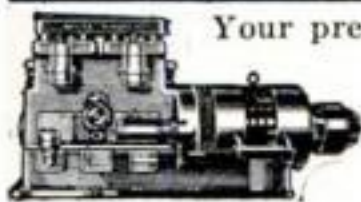
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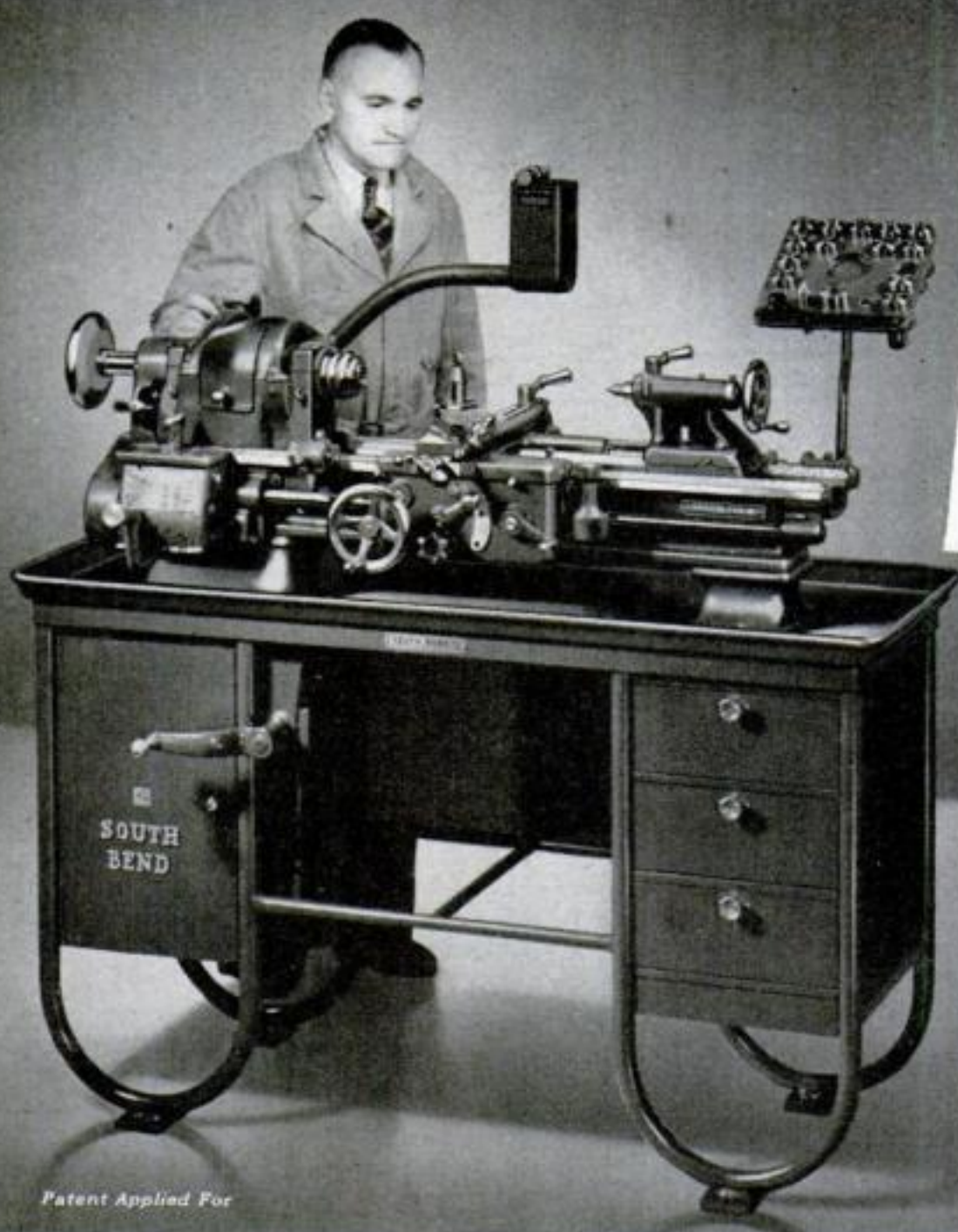
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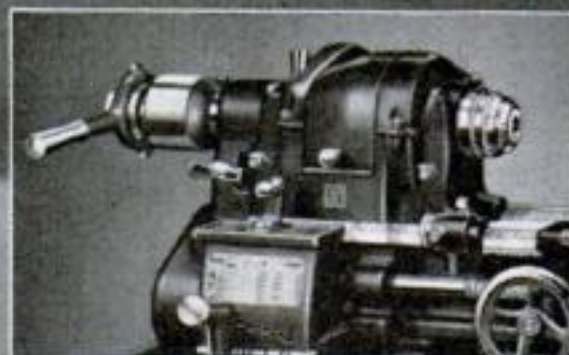
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The great strength of the United States is not its billions of gold, its tons of metal or its giant industrial capacity. It is the native mechanical skill and inventive power of its people.

In a crisis, this democracy always gives us the men and the ideas the nation needs.

Usually, we imagine that these ideas come from the scientific laboratories or from the drawing boards of engineers. Many do. But just as many and just as great ideas come from the men at the machines of industry.

For scientists, there is the Nobel Prize. For engineers, a score of awards. But there is no award for the gifted men now working at the lathes, forges and work benches of industry.

As a contribution to our national security, Revere Copper and Brass Incorporated is establishing an award of \$10,000.00 for the workmen in America's metal working industries.

Donald Dallas

PRESIDENT

REVERE COPPER AND BRASS INCORPORATED



The REVERE AWARD

of \$10,000 for Wage Earners in America's Metal Working Industries

THE Revere Award is made by Revere Copper and Brass Incorporated to help speed national defense by encouraging the mechanical genius and inventive talent of American wage earners.

The Revere Award totals \$10,000.00 divided as follows:

1st Award.....	\$5,000.00
2nd Award.....	2,500.00
3rd Award.....	1,000.00
4th to 9th Awards.....	250.00 each

The Revere Award is open to all wage earners (foremen and workingmen) in the metal and metal-working industries and to all machine maintenance men.

Each entry remains the property of the sender.

Selection will be made by an impartial Jury of

Award consisting of men high in science, labor, the Army, the Navy and industry. The decision of the Jury of Award will be final.

Winners will be chosen for the inventions, devices, improvements or ideas which, in the Jury's opinion, contribute most to speeding up America's Defense Program.

It is desired that all entries be placed at the command of the Defense Advisory Council at Washington, D. C., subject to the entrant's own written consent.

Two or more men may cooperate in any entry.

Entries close on midnight, April 30th, 1941.

For booklet giving complete details of the Revere Award and for Entry Blanks simply write to THE REVERE AWARD COMMITTEE, Washington, D. C.



"THOSE EXTRAS IN SLOWER-BURNING CAMELS CUT PLENTY OF ICE WITH ME!"

Says Hockey's "Dit" Clapper, Captain of the Boston Bruins

MILDNESS
IS A MUST WITH
ME. CAMELS SMOKE
EXTRA MILD AND
EXTRA COOL



CAMELS
SURE HAVE
THE FLAVOR —
EXTRA FLAVOR



FOURTEEN YEARS in one of the toughest games in sport. And he's still tops. Speed . . . endurance . . . Dit Clapper (*above*) has both in extra measure. He likes the extras in Camels, too. Camels burn slower and smoke with that extra measure of mildness and coolness that makes such a difference. There's another advantage in Camel's slower burning, too (*eyes right*).

S-L-O-W is the word for it, Dit—slow burning for extra flavor. Cigarettes that burn fast just naturally burn hot. And that excess heat dulls flavor and fragrance—leaves you with a flat, tasteless smoke. Slow burning lets the flavor come through in extra measure. Try the slower-burning cigarette. You'll notice the extra mildness, the extra coolness, the extra flavor. Your purse will notice the extra smoking per cigarette per pack (*see below*).



In recent laboratory tests, CAMELS burned 25% *slower* than the average of the 15 other of the largest-selling brands tested—*slower* than *any* of them. That means, on the average, a smoking *plus* equal to

**5 EXTRA SMOKES
PER PACK!**

EXTRA MILDNESS

EXTRA COOLNESS

EXTRA FLAVOR

R. J. Reynolds Tobacco Company, Winston-Salem, North Carolina

GET THE "EXTRAS" WITH SLOWER-BURNING CAMELS
THE CIGARETTE OF COSTLIER TOBACCOS